RESOLUTION
COPPER

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5 July 2020

Via email to: mary.rasmussen@usda.gov

Mary Rasmussen
US Forest Service
Supervisor's Office
2324E McDowell Road
Phoenix, AZ 85006-2496

Subject: Resolution Copper Mining, LLC – Mine Plan of Operations and Land Exchange – Response to Water Work Group Action Item WR-20

Dear Ms. Rasmussen,

As a follow up to the Water Work Group meeting on June 25, 2020 and in response to Water Work Group Action Item # WR-20 (*Provide Input on Potential for Stormwater Release and Estimate of Quality. Focus on Operations*) please see the response below with reference to Attachment 1. Attachment 1 contains an updated Power Point Presentation from the June 25th Water Work Group Meeting with additional clarification of source concentrations (slides 17, 18, 19 and associated notes).

Should you have any questions or require further information please do not hesitate to contact me.

Sincerely,

Vicky Peacey
Senior Manager, Permitting and Approvals; Resolution Copper Company, as Manager of Resolution Copper Mining LLC

Attachments:

Attachment 1 – Updated Resolution Copper Presentation to Water Work Group on June 25, 2020 "WR-20: Provide Input on Potential for Stormwater Release and Estimate of Quality. Focus on Operations."

Response to WR-20

WR-20: Provide Input on Potential for Stormwater Release and Estimate of Quality. Focus on Operations

Maest Comment

The DEIS states that stormwater contacting tailings would not be released or discharged to the environment at any time (p. 381). This belief is based on stormwater controls used for the tailings impoundments as part of the project. Even with reasonable mitigation measures, unexpected releases of stormwater can and will occur due to failures in design or construction of the mitigation measures, human error, storm events, and other causes. Climate change is causing more extreme storm events, and the design and operation of mine facilities must take this into account. Table 3 describes stormwater releases from large copper mines in Arizona, when they occurred, their effects, and the causes, when known. The report (Gestring, 2019) also includes releases of mine contaminants and tailings from dam failures, process facilities and other sources that are not included in Table 3. The mine contaminants associated with the releases in Table 3 included acidity, tailings, and metals such as copper and zinc. The stormwater releases adversely affected streams, soils, and groundwater and were caused by operator error, mechanical failures, and storm events. The DEIS should include all reasonably foreseeable effects, and Table 3 demonstrates that stormwater releases do occur with some regularity and should be fully evaluated as part of the potential environmental effects of the project.

RC Response to WR20

Regulatory Context

During operation of the TSF, the stormwater strategy at Skunk Camp tailings storage facility (TSF) is described in Chapter 3 of the DEIS and in the Process Memorandum to File entitled Water Resource Analysis: Assumptions, Methodology Used, Relevant Regulations, Laws, and Guidance, and Key Documents (Newell and Garrett, August 6, 2018).

First, run-on from upstream of the facility will be diverted around the facility so as to not come into contact with the TSF, thereby reducing the total amount of potential contact stormwater that will need to be handled. This will be accomplished by construction of diversion dams, ditches and pipelines upstream of the TSF (e.g., in Skunk Camp and Stone Cabin washes). The dams are not intended to permanently impound water, but instead to temporarily hold it until it can be released (i.e., they are designed as detention dams, not retention dams). In addition, diversion channels will be constructed on the east and west sides of the TSF to convey unimpacted runoff to Dripping Spring Wash. All dams and diversion channels would be designed to handle the 100-year, 24-hour storm event (peak flow or volume without release or pumping. This non-contact stormwater is not considered stormwater “associated with industrial activity” pursuant to 40 C.F.R. § 122.26(a)(14)(iii) because it has not “come into contact with, any overburden, raw material, intermediate products, finished products, by-products or waste products” located on the mining site. This non-contact water is therefore not regulated by the Clean Water Act (CWA). See also 33 U.S.C. § 1342(l)(2) (no permit required for stormwater at a mining site that has not “come into contact with, any overburden, raw material, intermediate products, finished product, by-product, or waste products" located on the mining site).

Second, water falling on top of the TSF will flow into the recycled water pond on top of the TSF and not be discharged. Fluids on the top of the TSF may be considered process wastewater and cannot be discharged under applicable effluent limitation guidelines except in the event of a storm event exceeding the 10-year, 24-hour event, provided certain other conditions are met. See 40 C.F.R. § 440.131. The TSF has been designed to handle storm events above and beyond that event.

Third, water contacting the TSF embankments will be captured in collection ditches constructed along the embankment toe and conveyed to seepage collection ponds for reuse. The intention is not to discharge this stormwater, although such discharge may be allowable under the governing state AZPDES general stormwater permit. Stormwater runoff that has contacted the embankment of a TSF (whether constructed of tailings or not) is considered stormwater under the CWA so long as it is not comingled with process fluids or mine drainage. See Arizona Pollutant Discharge Elimination System General Permit for Stormwater Discharges Associated with Industrial Activity – Mineral Industry (AZMSG2019-002) (Mining MSGP), Part 8.G.1.1 and Table 8.G.1.1 (specifying stormwater discharges covered by the permit). As such, it may be discharged under the Mining MSGP, provided permit terms are complied with. For such discharges to be authorized under the Mining MSGP (among other requirements): (1) the discharges must meet criteria specified in Parts 2.0 and 8.G.2 of the Mining MSGP; (2) the permittee must develop and implement appropriate site-specific stormwater control measures outlined in a stormwater pollution prevention plan (Mining MSGP Parts 2.2, 5.0, 8.G.4, 8.G.5 and 8.G.6); (3) discharges must be assessed visually (Mining MSGP Part 4.2) and analyzed for specified parameters (Mining MSGP Parts 6.0 and 8.G.8), with analytical monitoring results reported to ADEQ within 30 days of receipt (Mining MSGP, Part 6.5); (4) the facility must be periodically inspected (Mining MSGP Parts 4.1 and 8.G.7); and (5) the permittee must take corrective action if certain triggering events occur (Mining MSGP, Part 3.0).

Even operators who do not intend to discharge stormwater often obtain stormwater discharge permits. Resolution Copper intends to obtain coverage under the Mining MSGP to cover the eventuality whereby water that has contacted the TSF embankment is released to a downstream water.

It is also worth noting that as a condition of obtaining a required aquifer protection permit for the Skunk Camp TSF, the applicant's design also will have to meet best available demonstrated control technology (BADCT) criteria relating to stormwater control at TSFs. See Arizona Mining BADCT Guidance Manual, §§ 2.5.1.2 (prescriptive BADCT), 3.5.4.2 (individual BADCT) & Appendix E. BADCT recommends a minimum storm event of a 100-year and the TSF is designed well above that criteria (greater than the 72-hour Probable Maximum Flood (PMF) conservatively assuming no diversion of upstream stormwater around the facility).

As a final note, Table 3 of the comment from Maest identifies 8 instances of purported stormwater releases in the last 39 years. Several of these releases (at least two, and possibly three) do not appear to be stormwater releases, as described. As such, it puts in question whether this demonstrates that stormwater releases occur with “some regularity,” as alleged in the comment. Nevertheless, in response to this comment, the likely quality of a potential unintended stormwater release for an extreme stormwater event and the likely effects thereof on potential receiving waters (which are all ephemeral in the vicinity of the site) has been modeled in response to comment and disclosure in the final EIS.

Evaluation of Stormwater Release from Extreme Event and Estimate of Quality during Operations

An evaluation was completed of water quality impacts from potential stormwater release from the proposed Skunk Camp tailings storage facility (TSF) and appurtenant downstream management structures. Unlike the historic mines cited by Buka Environmental (2019), the proposed Skunk Camp TSF is a modern design sized for greater than the 72-hour Probable Maximum Flood (PMF) conservatively assuming no diversion of upstream stormwater around the facility. The seepage collection pond (SCP) located downstream of the TSF is sized for an operating pond, a upset condition (a week’s worth of inflows without outflow, i.e., pumping), and the 200-year 24-hour storm volume without use of any planned pumping. In addition to the storage contingencies, the SCP will also have a state of the art monitoring and control systems and system redundancies (e.g., for pumps) will be used to minimize the potential for operational releases. Further, RCM will segregate the scavenger tailings, used in the embankment construction from the pyrite tailings, a reactive mineral waste management strategy not practiced by the large historic copper mines in Arizona. Stormwater that could be released from the SCP will only contact the scavenger tailings used in the embankment.

An analysis of water quality from an extreme storm event has been completed and presented during the June 25, 2020 Water Work Group meeting (Attachment 1). Discharge from the SCP during extreme storm events could occur at or above a return period of 300 years, for which the annual probability of occurrence during operations is less than 0.5% and less than a probability of 15% for the entire planned life of mine. The probability of occurrence for both an extreme storm and an operational upset condition happening at the same time in the SCP is even lower. Were a stormwater discharge to occur from an extreme event (up to 1000-year return period storm event), conservative predictions indicate a potential for exceeding the ephemeral acute aquatic and wildlife for only copper in Dripping Springs Wash and only in a section of the wash above the confluence with Silver Creek drainage. None of the predictions indicated exceedances of any water quality standard at the confluence with the Gila River. Any impacts to water quality would be transient and short-lived as a result of chemical reactions and dilution by groundwater inflow and subsequent stormflows.

June 2020

Resolution Copper Project
EIS Water Working Group
WR-20 Stormwater Quality Action Item

WR-20: Provide Input on Potential for Stormwater Release and Estimate of Quality. Focus on Operations.

Overview

- Introduction
- Review of Skunk Camp TSF stormwater management
- What happens during the 300-year to 1000-year events?
  - Stormwater release volumes and downstream dilution
  - Release water quality
- Conclusion / discussion

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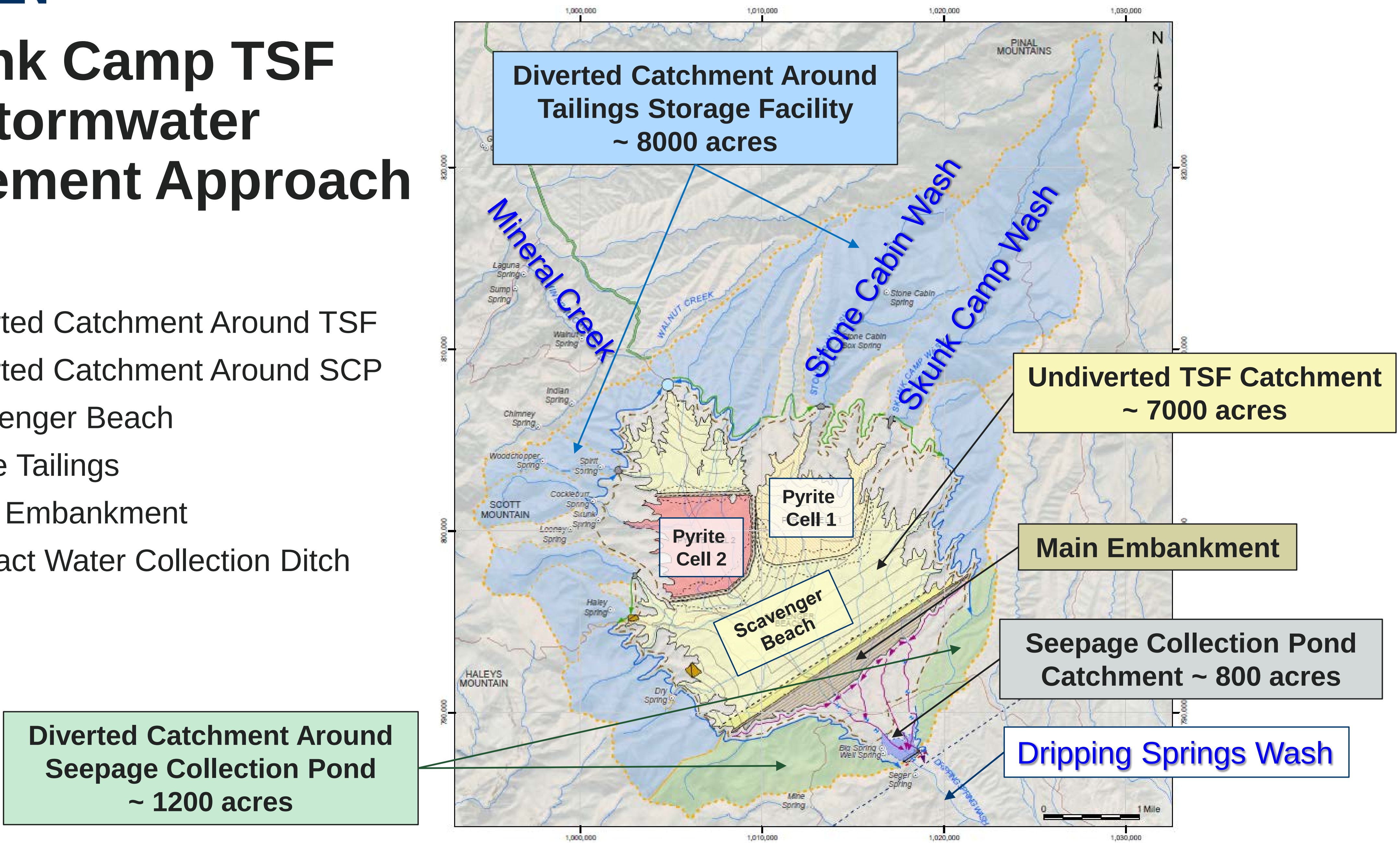
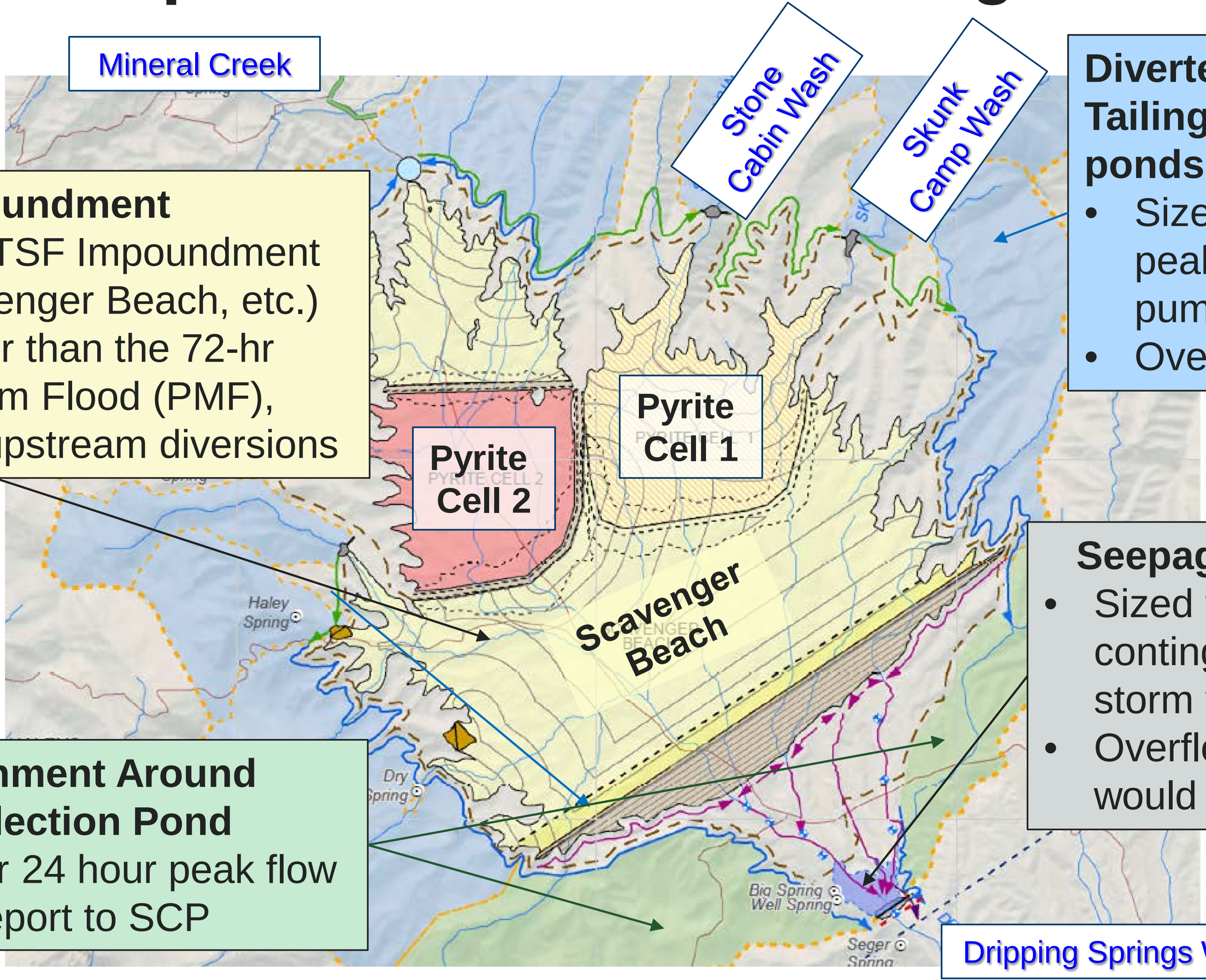
Skunk Camp TSF Stormwater Management Approach

Legend

- Diverted Catchment Around TSF
- Diverted Catchment Around SCP
- Scavenger Beach
- Pyrite Tailings
- Main Embankment
- Contact Water Collection Ditch



Skunk Camp TSF Stormwater Management Approach



TSF Impoundment

- Each area of the TSF Impoundment (Pyrite Cell, Scavenger Beach, etc.) is sized for greater than the 72-hr Probable Maximum Flood (PMF), *ASSUMING NO* upstream diversions

Diverted Catchment Around Tailings Storage Facility (dams, ponds, ditches, pumps, pipes)

- Sized for 100-year 24 hour peak flow or volume *without* pumping
- Overflow would report to TSF

Seepage Collection Pond (SCP)

- Sized for operational pond, upset contingency, and 200-year 24 hour storm volume *without* pumping
- Overflow from emergency spillway would report downstream

Diverted Catchment Around Seepage Collection Pond

- Sized for 100-year 24 hour peak flow
- Overflow would report to SCP

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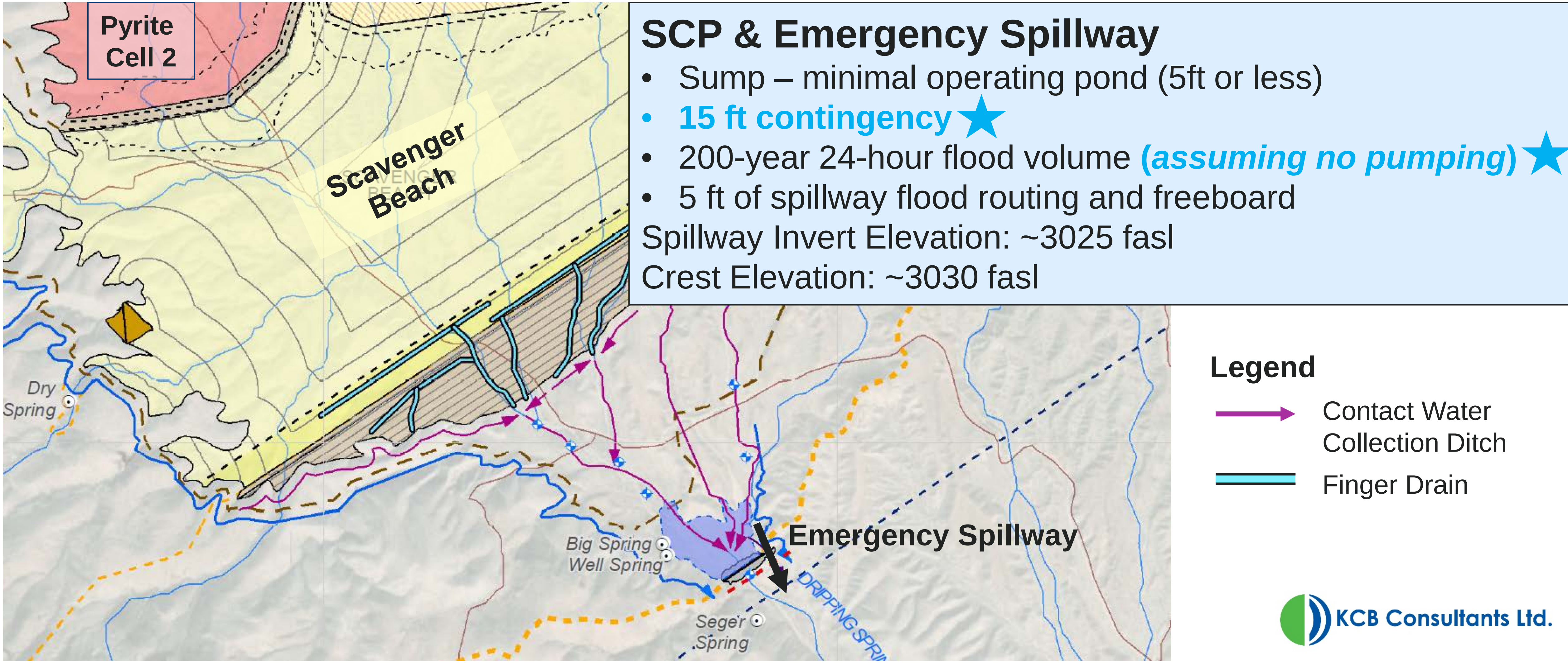
Seepage Collection Pond Stormwater Management



SCP & Emergency Spillway

- Sump – minimal operating pond (5ft or less)
- **15 ft contingency** ★
- 200-year 24-hour flood volume ***(assuming no pumping)*** ★
- 5 ft of spillway flood routing and freeboard

Spillway Invert Elevation: ~3025 fasl

Crest Elevation: ~3030 fasl

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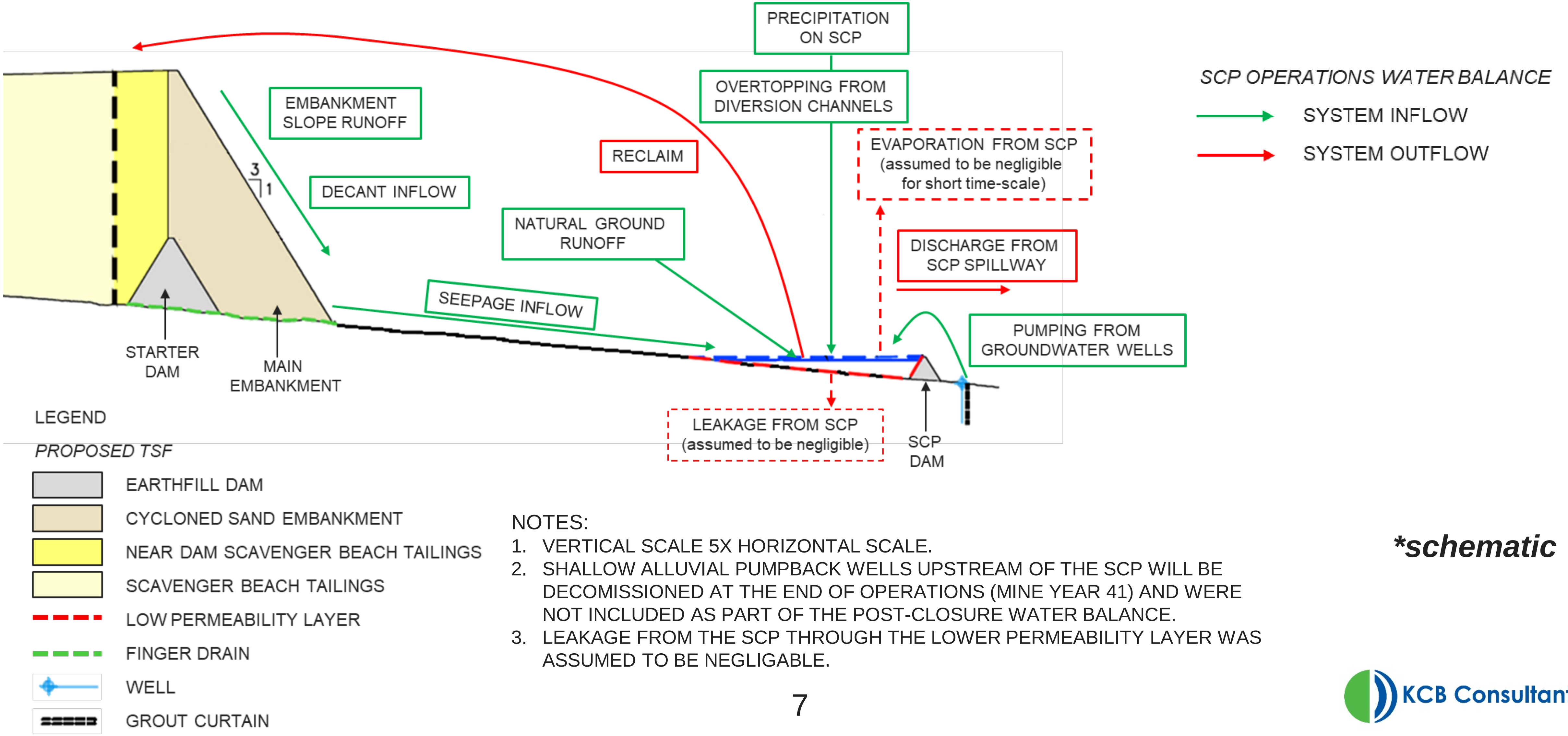
Seepage Collection Pond Design and Stormwater Management



NOTES:
1. VERTICAL SCALE 5X HORIZONTAL SCALE.
2. SHALLOW ALLUVIAL PUMPBACK WELLS UPSTREAM OF THE SCP WILL BE DECOMISSIONED AT THE END OF OPERATIONS (MINE YEAR 41) AND WERE NOT INCLUDED AS PART OF THE POST-CLOSURE WATER BALANCE.
3. LEAKAGE FROM THE SCP THROUGH THE LOWER PERMEABILITY LAYER WAS ASSUMED TO BE NEGLIGABLE.

**schematic*

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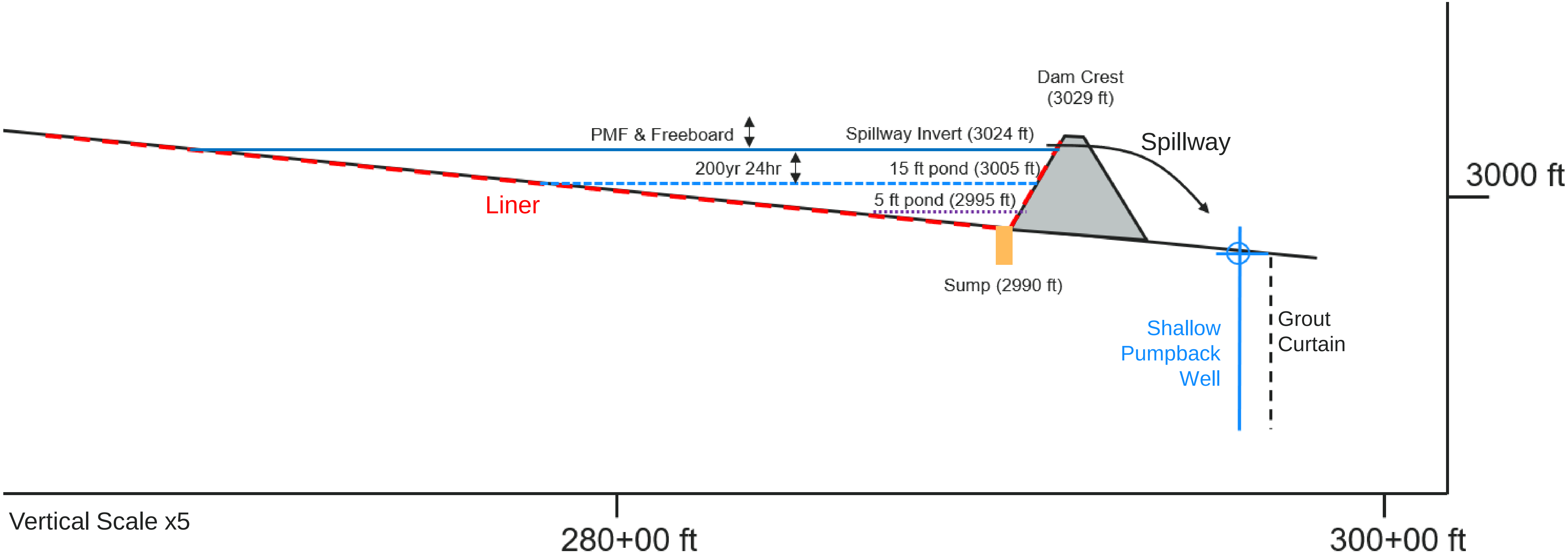
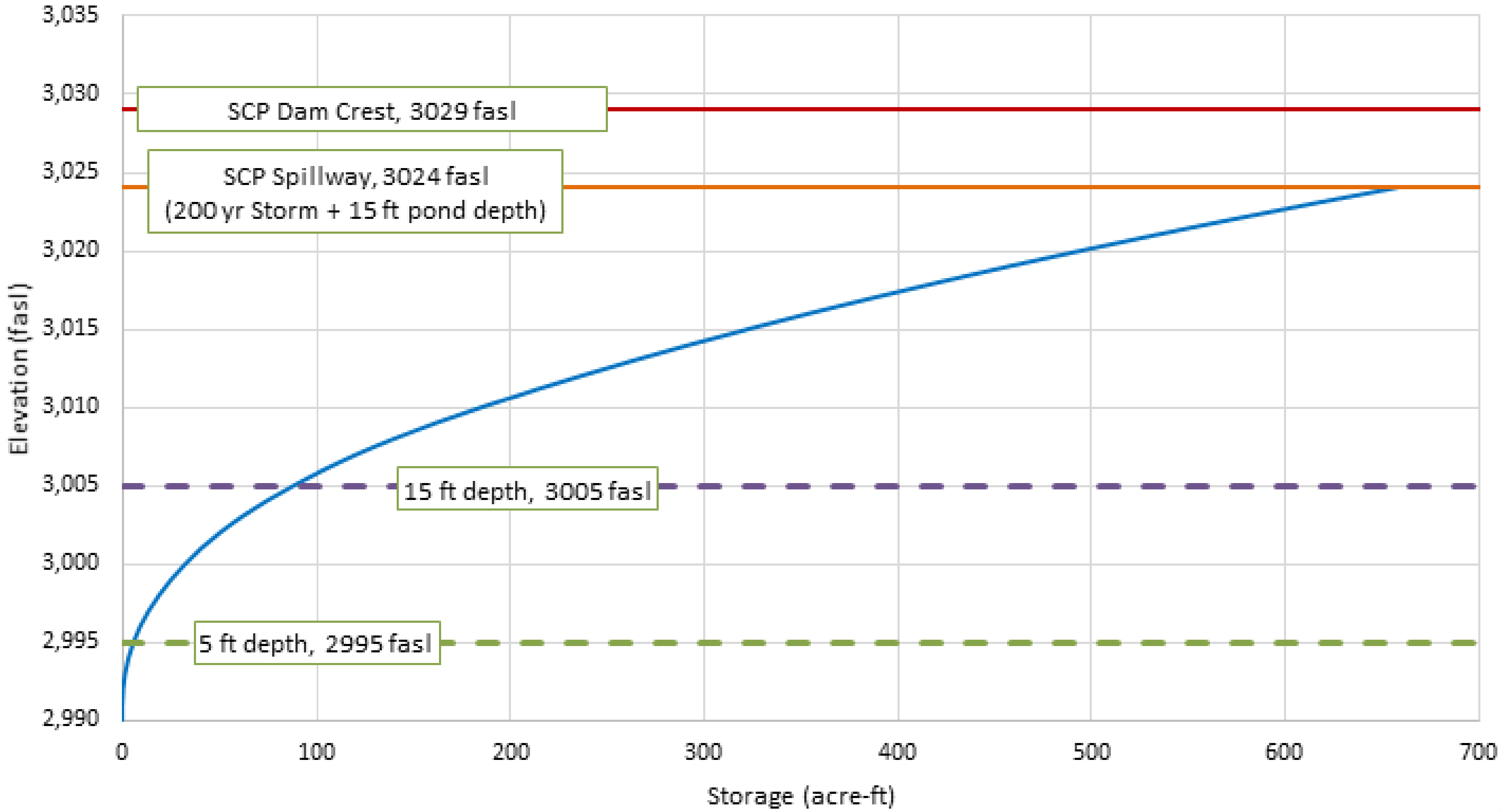
Seepage Collection Pond Design and Stormwater Management



**schematic*

Seepage Collection Pond Stage-Storage Curve



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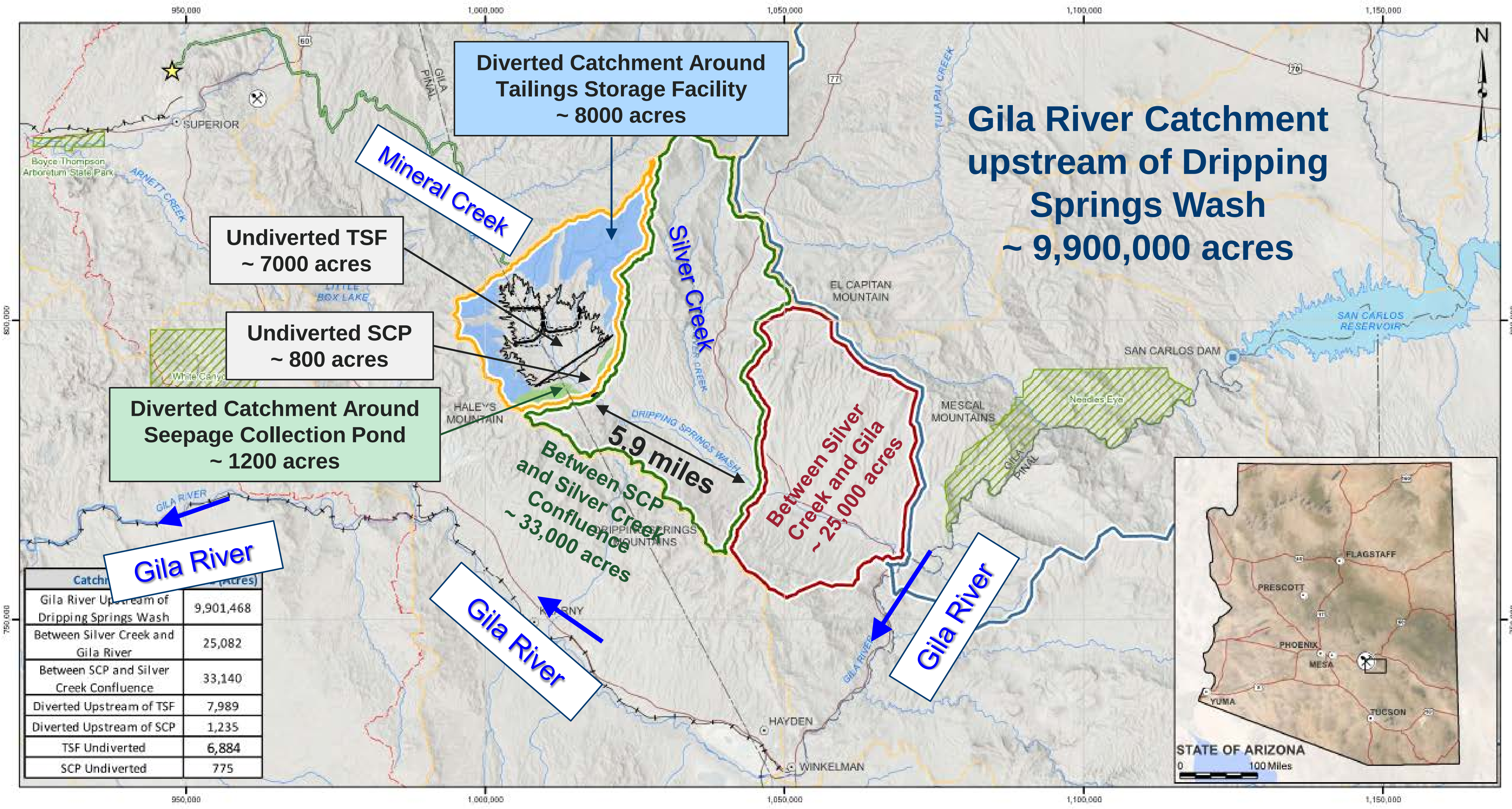
TSF Design for Operational Upset

- SCP Storm Storage Contingency
  - Upset conditions: one week of pump shut-down ~ up to 15 ft pond depth
  - Plus 200-year 24-hour inflow[1] *WITHOUT* pumping
- TSF Storm Storage Contingency
  - 72hr PMF
- State of Practice Operating Management (corporate & GTS)
  - Redundancy in pumping
  - Monitoring systems

Note 1: assuming runoff co. of 1.0

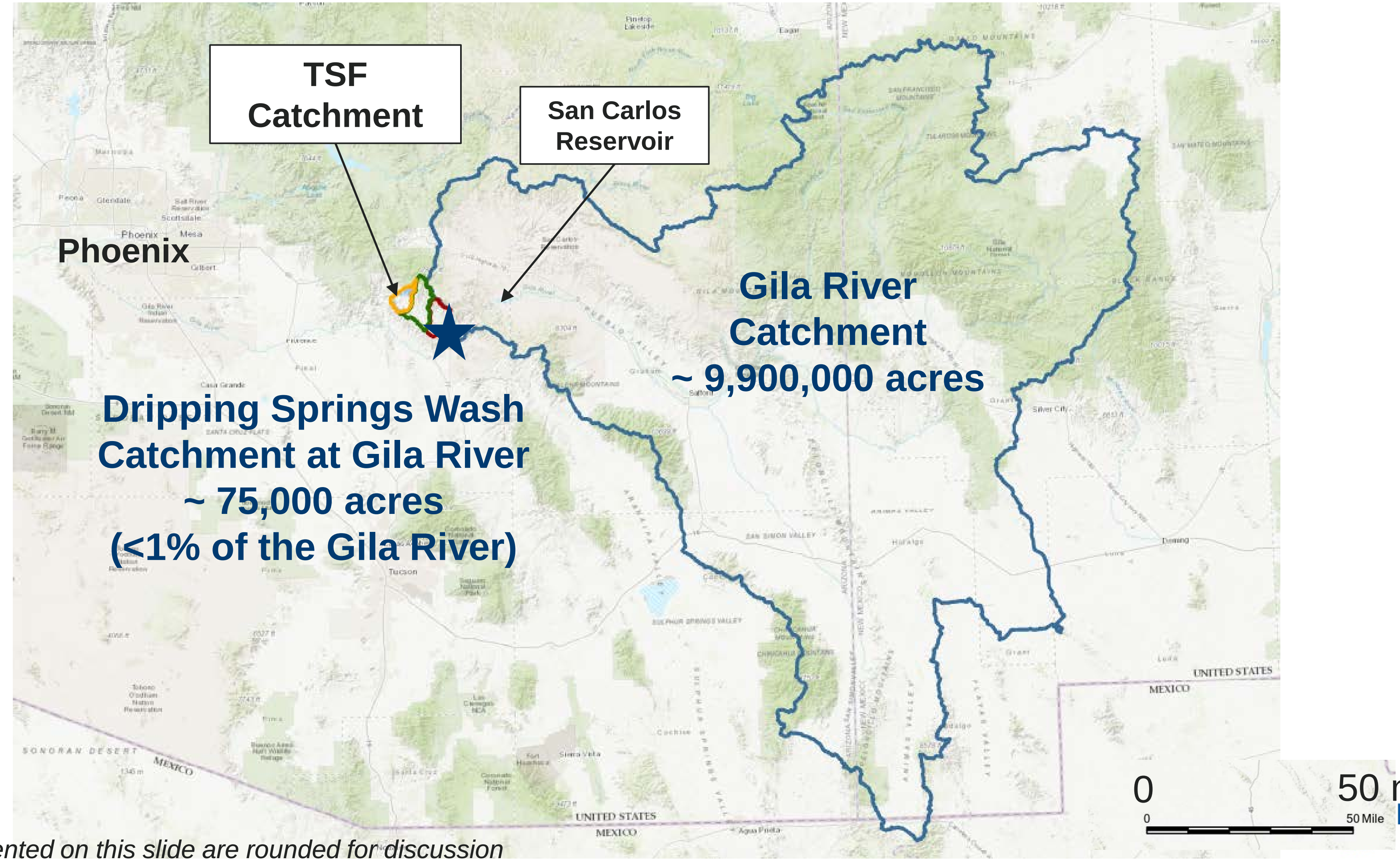
Downstream Context for TSF Stormwater Management



Catchm...	(Acres)
Gila River Up... of Dripping Springs Wash	9,901,468
Between Silver Creek and Gila River	25,082
Between SCP and Silver Creek Confluence	33,140
Diverted Upstream of TSF	7,989
Diverted Upstream of SCP	1,235
TSF Undiverted	6,884
SCP Undiverted	775

Note: Catchment areas presented on this slide are rounded for discussion

Downstream Context for TSF Stormwater Management



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WR-20: Provide Input on Potential for Stormwater Release and Estimate of Quality. Focus on Operations.

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Extreme Flood Scenarios

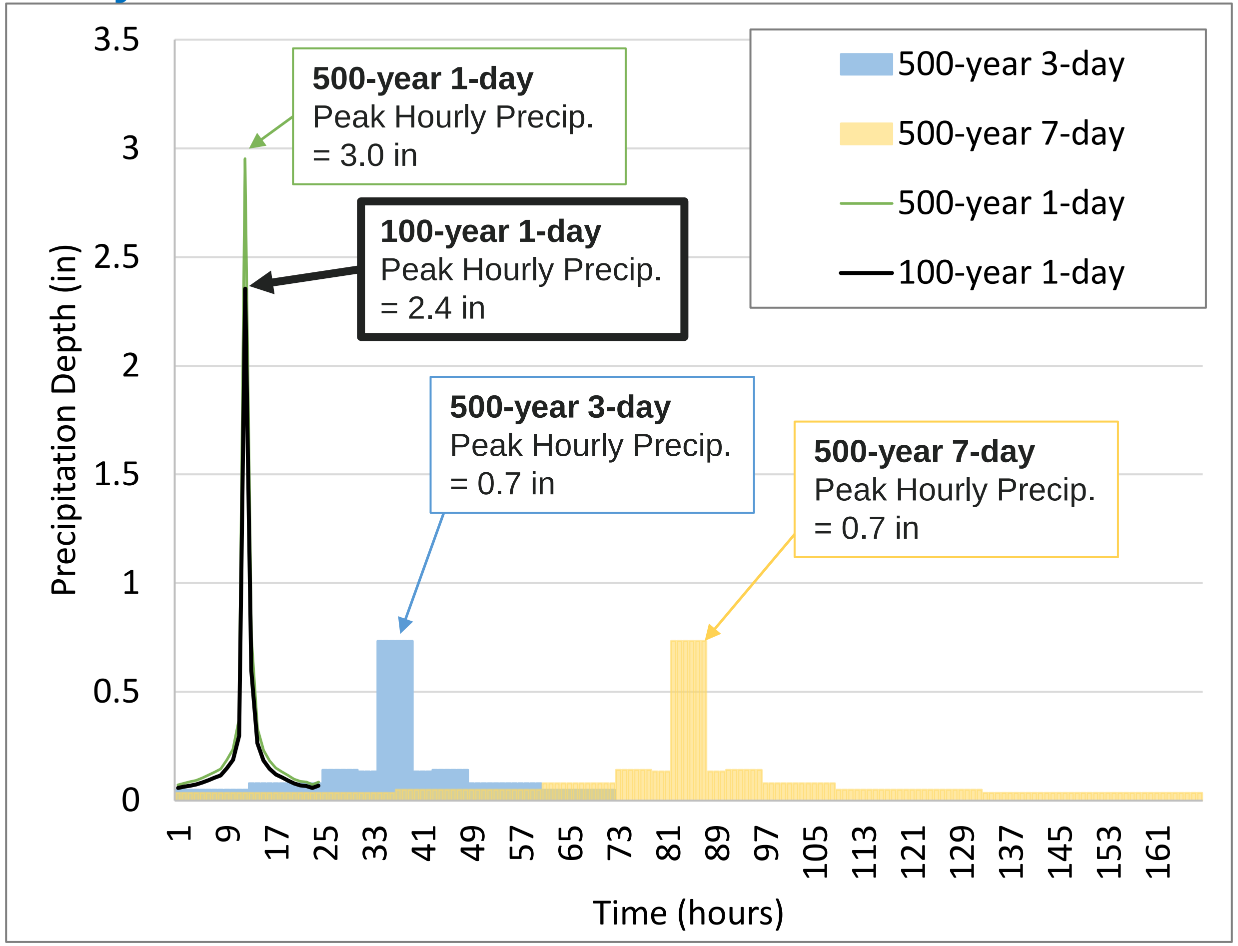
- Flood Return Periods
  - 1 in 300-yr
  - 1 in 400-yr
  - 1 in 500-yr
  - 1 in 1000-yr

Return Period	Annual Exceedance Probability (AEP)	Probability over the Life of Mine (41 years)
1 in 300-yr	0.33%	13%
1 in 400-yr	0.25%	10%
1 in 500-yr	0.2%	8%
1 in 1000-yr	0.1%	4%

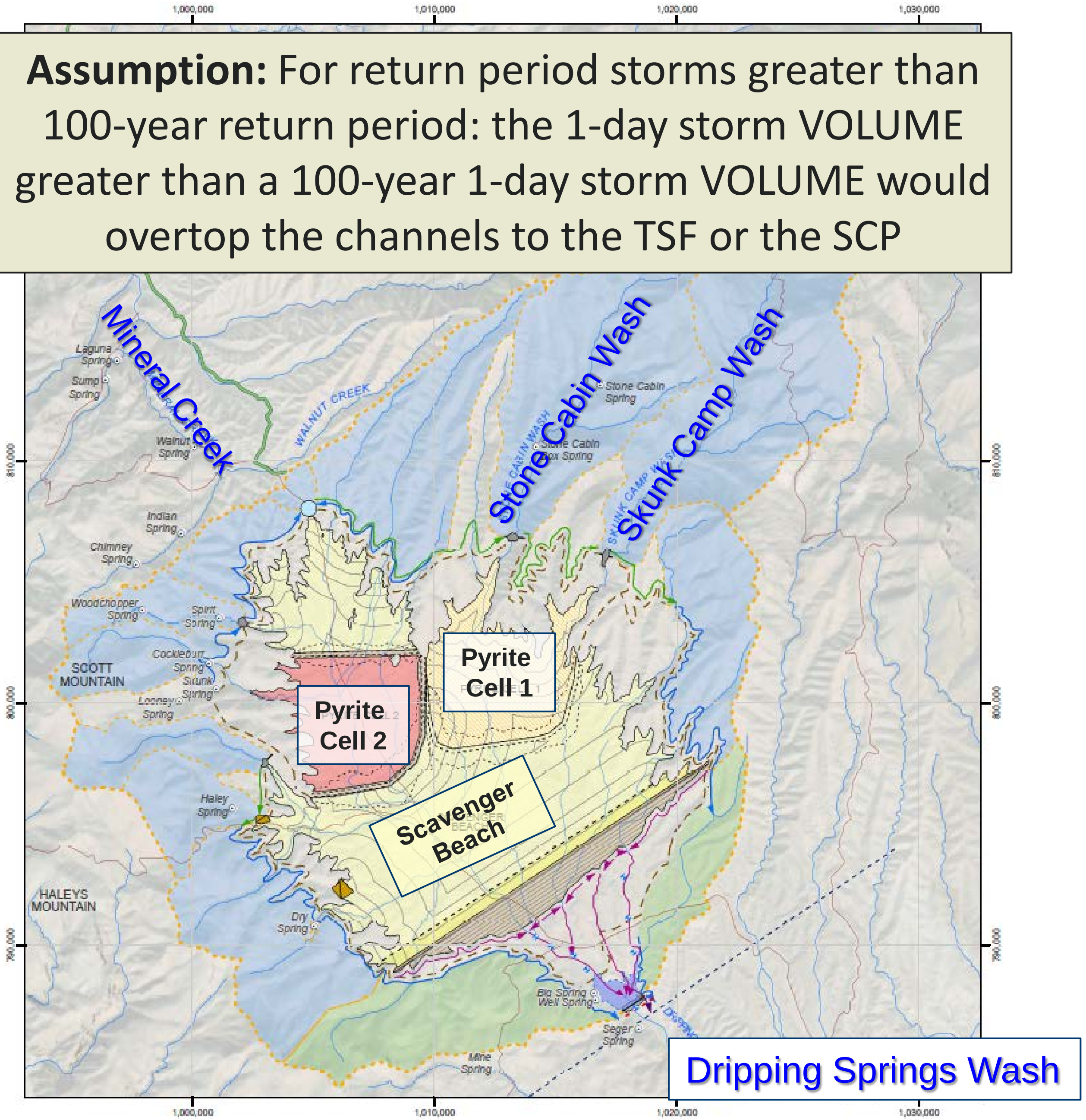
- Flood Durations
  - 1-day
  - 3-day
  - 7-day
  - 30-day
- Initial SCP Pond
  - 5 ft initial pond depth
  - *10 ft initial pond depth (greater than the target pond depth)*
  - *15 ft initial pond depth (represents upset conditions: e.g. pump down, back-to-back storms)*

Storm Distributions and 1-Day Event Diversion Spill Assumption

500-year Storm Events

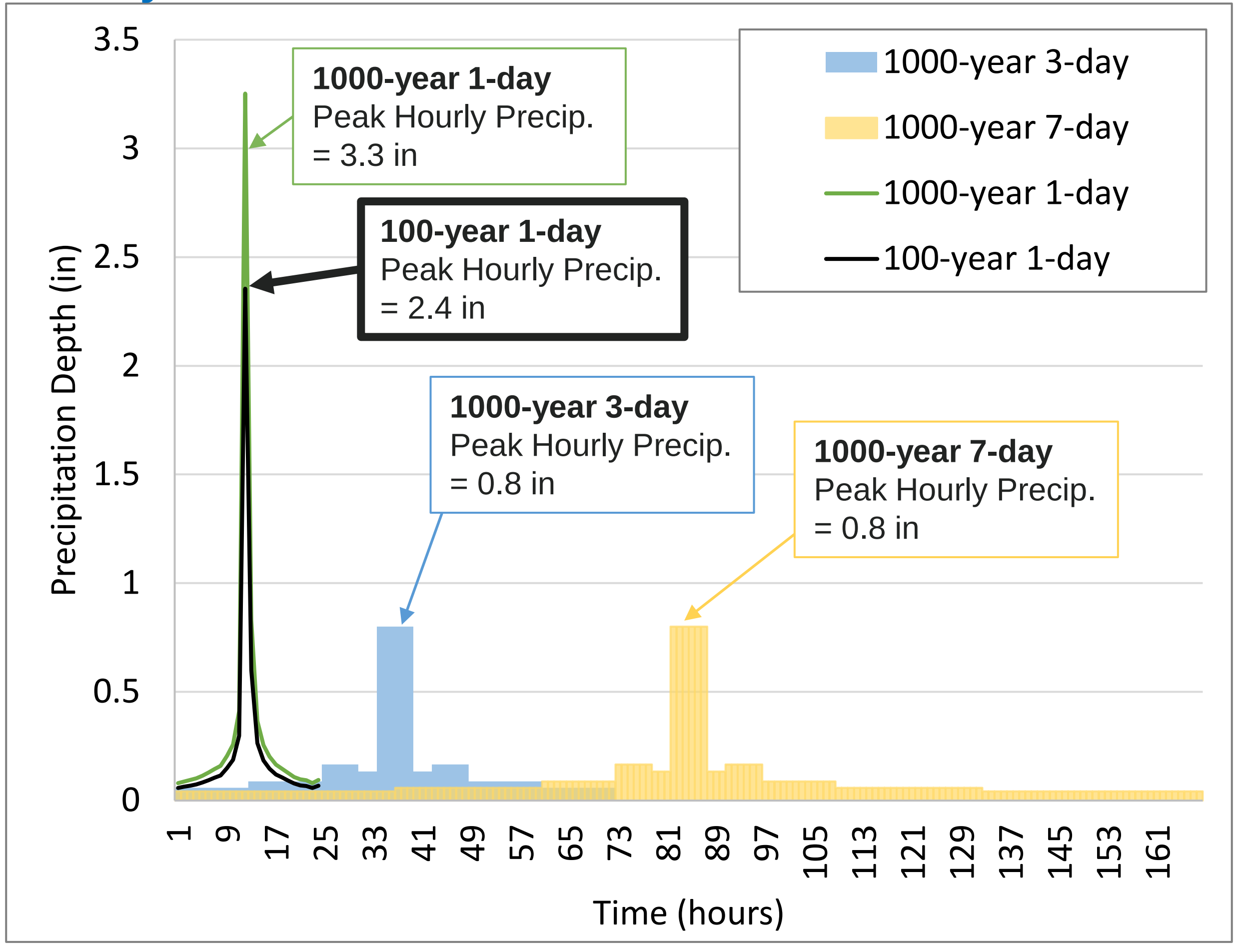


Assumption: For return period storms greater than 100-year return period: the 1-day storm VOLUME greater than a 100-year 1-day storm VOLUME would overtop the channels to the TSF or the SCP

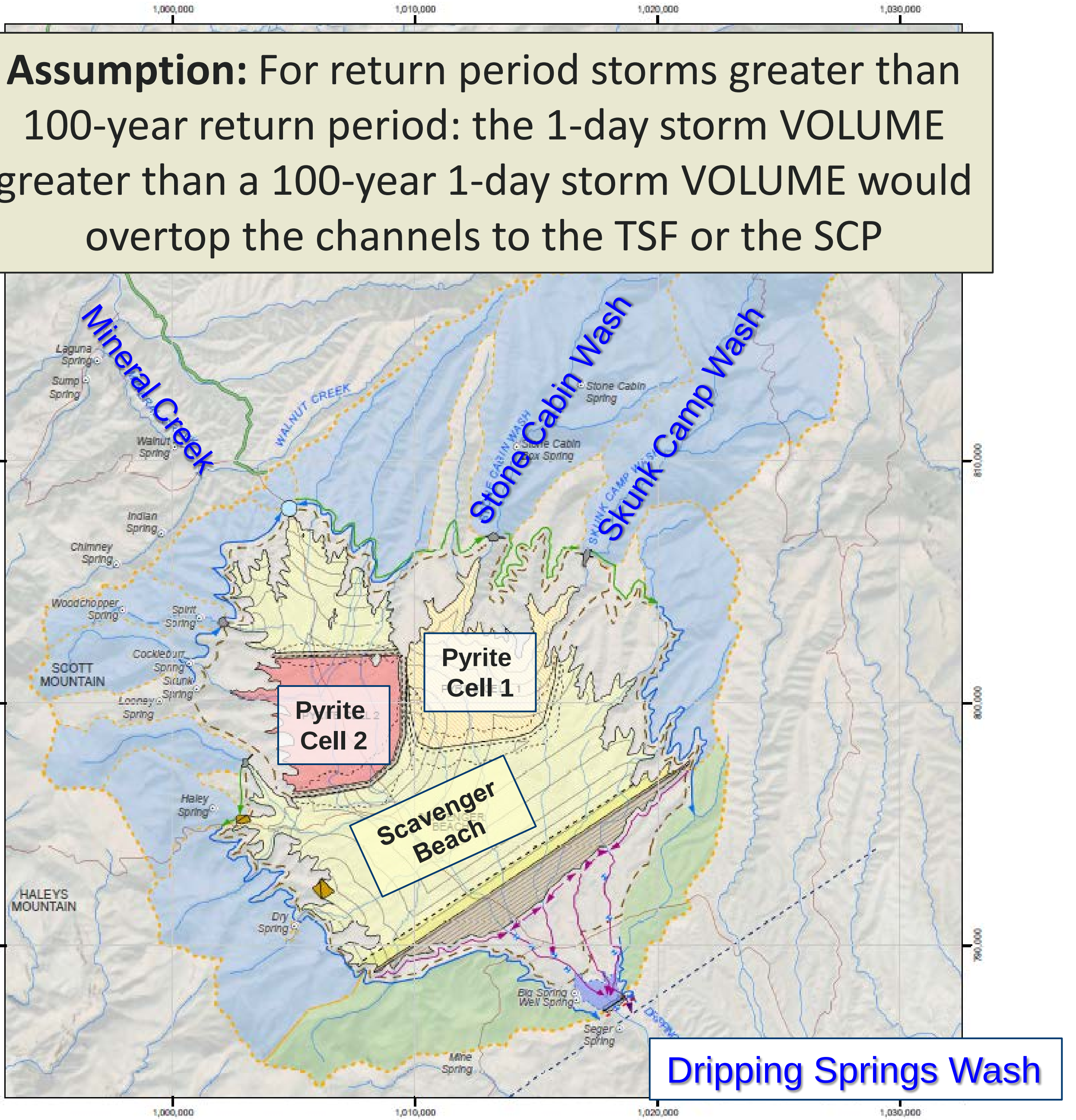


Storm Distributions and 1-Day Event Diversion Spill Assumption

1000-year Storm Events



Assumption: For return period storms greater than 100-year return period: the 1-day storm VOLUME greater than a 100-year 1-day storm VOLUME would overtop the channels to the TSF or the SCP



Water Quality Predictions

Concentration based

No reactive chemistry (no chemical precipitation or sorption)

Dissolved chemistry only

Average concentrations in stormwater contacting embankment scavenger tailings assumed to decrease through dilution with increasing storm duration

Water Quality Standards

Acute aquatic and wildlife (ephemeral) (Acute A&We)

The use of an ephemeral water by animals, plants, or other organisms, excluding fish, for habitation, growth, or propagation

Fixed

- *Arsenic, Iron, Selenium, Chromium (min. of Cr[VI] and C[III])*

Hardness dependent (~65 mg/L as $CaCO_3$)

- *Cadmium, **Copper**, Lead, Nickel, Silver, Zinc*
- *Calculated copper standard ~0.016 mg/L*

Water Quality Predictions (cont.)

Average concentrations in stormwater contacting embankment scavenger tailings likely to decrease with increasing storm duration through dilution

Starting concentration based on average of weekly leachates from humidity cells for weeks 0, 1, and 2 (Eary 2018)

The decline in daily concentrations was approximated assuming 50% reduction for each storm day (source concentration half-life of 1 day)

For example, the approximated concentration for Cu is the average of daily values

- *1 Day Duration - 9.8 mg/L (Eary 2018)*
- *3 Day Duration - 5.7 mg/L (i.e. average of 9.8, 4.9, and 2.45 mg/L)*
- *7 Day Duration - 2.8 mg/L (i.e. average of 9.8, 4.9, 2.45, 1.23, 0.61, 0.31 and 0.15 mg/L)*
- *30 Day Duration - 0.56 mg/L*

This approximation assumes half of solutes removed daily during storm by runoff and infiltration

Water Quality Predictions (cont.)

Average of the weekly humidity cell test results from 12 master composites of scavenger tailings (Duke HydroChem 2016) weighted by lithology in ore body

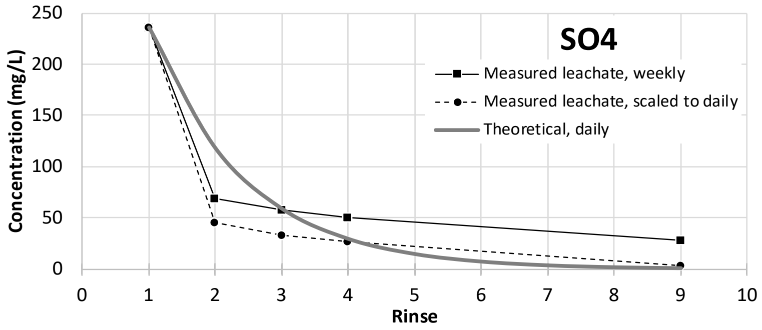
Weekly leachate concentrations scaled to daily using week 10 leachates (examples provided in graphs)

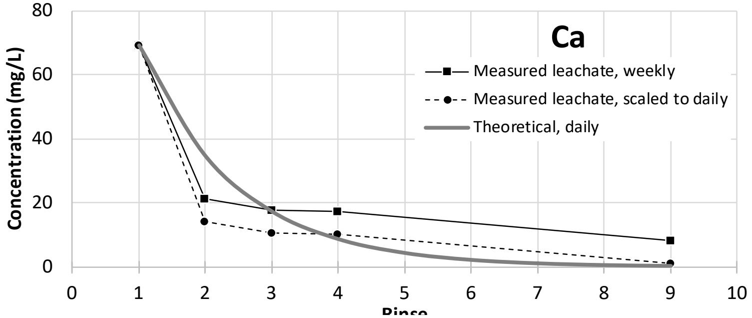
Approximated decrease overpredicts measured concentrations in early time and underpredicts concentrations in late time

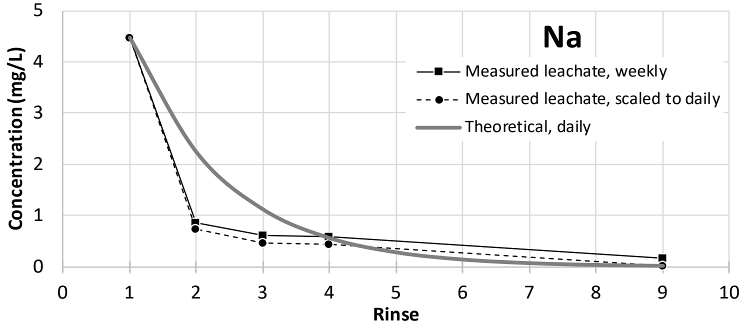
However, the average of daily approximated values used in the predictions is higher than average of daily values from the humidity cells, and is therefore conservative:

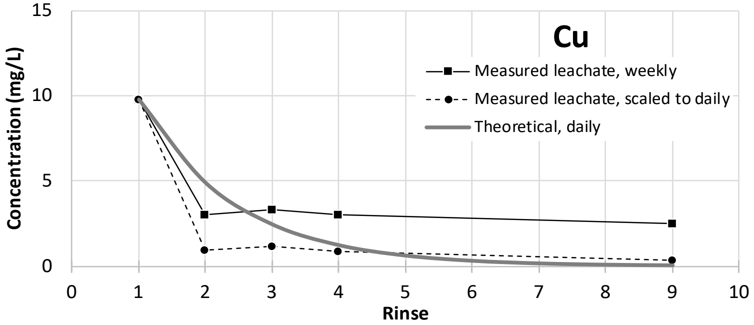
Storm Duration	Theor.	SO_4	Ca	Na	Cu
1-day	1.0	1.0	1.0	1.0	1.0
3-day	0.58	0.44	0.45	0.42	0.40
7-day	0.33	0.24	0.26	0.22	0.21

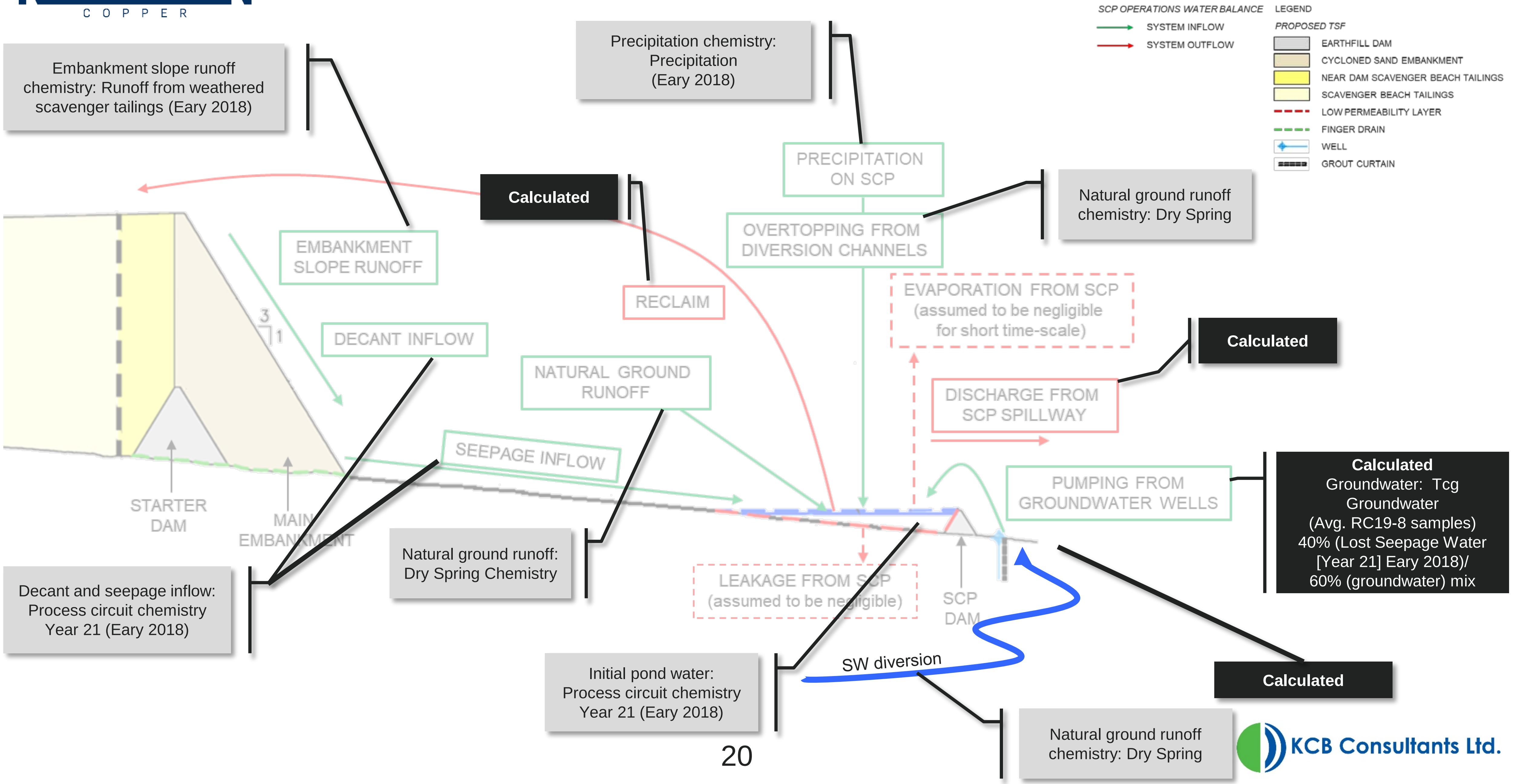
Normalized to a unit concentration










SCP OPERATIONS WATER BALANCE
SYSTEM INFLOW
SYSTEM OUTFLOW
LEGEND
PROPOSED TSF
EARTHFILL DAM
CYCLONED SAND EMBANKMENT
NEAR DAM SCAVENGER BEACH TAILINGS
SCAVENGER BEACH TAILINGS
LOW PERMEABILITY LAYER
FINGER DRAIN
WELL
GROUT CURTAIN
Embankment slope runoff chemistry: Runoff from weathered scavenger tailings (Eary 2018)
Precipitation chemistry: Precipitation (Eary 2018)
Calculated
PRECIPITATION ON SCP
OVERTOPPING FROM DIVERSION CHANNELS
Natural ground runoff chemistry: Dry Spring
EMBANKMENT SLOPE RUNOFF
RECLAIM
EVAPORATION FROM SCP (assumed to be negligible for short time-scale)
3
1
DECANT INFLOW
Calculated
NATURAL GROUND RUNOFF
DISCHARGE FROM SCP SPILLWAY
SEEPAGE INFLOW
PUMPING FROM GROUNDWATER WELLS
Calculated
Groundwater: Tcg Groundwater
(Avg. RC19-8 samples)
40% (Lost Seepage Water [Year 21] Eary 2018)/
60% (groundwater) mix
STARTER DAM
MAIN EMBANKMENT
Natural ground runoff: Dry Spring Chemistry
LEAKAGE FROM SCP (assumed to be negligible)
SCP DAM
Decant and seepage inflow: Process circuit chemistry Year 21 (Eary 2018)
SW diversion
Calculated
Initial pond water: Process circuit chemistry Year 21 (Eary 2018)
Natural ground runoff chemistry: Dry Spring
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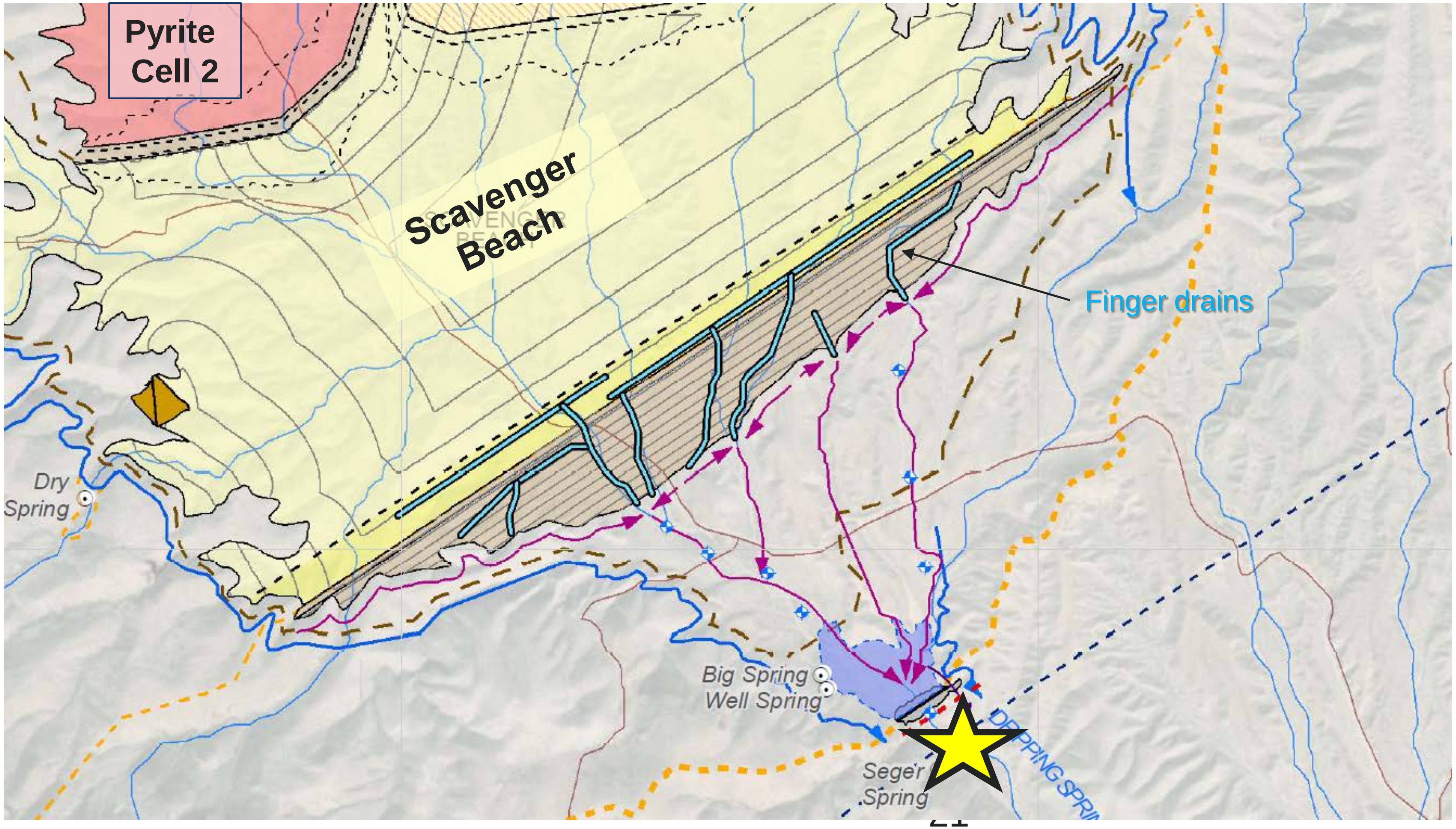
Results Just Downstream of SCP



Legend

- Contact Water Collection Ditch
- Finger Drain

Hydrologic Results – 1 in 300-yr Flood

Source of Water Discharge to the Downstream Environment	1 in 300-yr Flood Scenario Volumes			
	*1-Day	3-Day	7-Day	30-Day
Volume from Upstream Catchments (Diverted Around TSF) ***(acre-ft)***				
Upstream Catchments (Diverted Around TSF)	2930	n/a	n/a	n/a
Volume from SCP Spillway Discharge ***(acre-ft)***				
5 ft Initial SCP Pond Depth	0	0	0	0
10 ft Initial SCP Pond Depth	0	0	0	0
15 ft Initial SCP Pond Depth (upset)	*40*	*0*	*0*	*0*
Total Volume to Downstream Environment ***(acre-ft)***				
5 ft Initial SCP Pond Depth	2930	-	-	-
10 ft Initial SCP Pond Depth	2930	-	-	-
15 ft Initial SCP Pond Depth (upset)	*2970*	*-*	*-*	*-*
Dilution Ratio of SCP Spill at SCP Outlet (Volume from Upstream Catchments (Diverted Around TSF) ***/*** *Volume from SCP Spillway Discharge)* ***(ratio)***				
5 ft Initial SCP Pond Depth	-	-	-	-
10 ft Initial SCP Pond Depth	-	-	-	-
15 ft Initial SCP Pond Depth (upset)	*73*	*-*	*-*	*-*

Legend
No Discharge from SCP
Discharge from SCP Spillway

*Note: For return period storms greater than 100-year return period: the 1-day storm VOLUME greater than a 100-year 1-day storm VOLUME would overtop the channels to the TSF or the SCP

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Hydrologic Results – 1 in 400-yr Flood

Source of Water Discharge to the Downstream Environment	1 in 400-yr Flood Scenario Volumes			
	*1-Day	3-Day	7-Day	30-Day
Volume from Upstream Catchments (Diverted Around TSF) ***(acre-ft)***				
Upstream Catchments (Diverted Around TSF)	2930	n/a	5400	n/a
Volume from SCP Spillway Discharge ***(acre-ft)***				
5 ft Initial SCP Pond Depth	5	0	0	0
10 ft Initial SCP Pond Depth	30	0	0	0
15 ft Initial SCP Pond Depth (upset)	*90*	*0*	*40*	*0*
Total Volume to Downstream Environment ***(acre-ft)***				
5 ft Initial SCP Pond Depth	2935	-	-	-
10 ft Initial SCP Pond Depth	2960	-	-	-
15 ft Initial SCP Pond Depth (upset)	*3020*	*-*	*5440*	*-*
Dilution Ratio of SCP Spill at SCP Outlet (Volume from Upstream Catchments (Diverted Around TSF) ***/*** *Volume from SCP Spillway Discharge)* ***(ratio)***				
5 ft Initial SCP Pond Depth	586	-	-	-
10 ft Initial SCP Pond Depth	98	-	-	-
15 ft Initial SCP Pond Depth (upset)	*33*	*-*	*135*	*-*

Legend
No Discharge from SCP
Discharge from SCP Spillway

*Note: For return period storms greater than 100-year return period: the 1-day storm VOLUME greater than a 100-year 1-day storm VOLUME would overtop the channels to the TSF or the SCP

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Hydrologic Results – 1 in 500-yr Flood

Source of Water Discharge to the Downstream Environment	1 in 500-yr Flood Scenario Volumes			
	*1-Day	3-Day	7-Day	30-Day
Volume from Upstream Catchments (Diverted Around TSF) ***(acre-ft)***				
Upstream Catchments (Diverted Around TSF)	2930	4400	5450	n/a
Volume from SCP Spillway Discharge ***(acre-ft)***				
5 ft Initial SCP Pond Depth	40	0	5	0
10 ft Initial SCP Pond Depth	70	0	30	0
15 ft Initial SCP Pond Depth (upset)	*130*	*30*	*90*	*0*
Total Volume to Downstream Environment ***(acre-ft)***				
5 ft Initial SCP Pond Depth	2970	-	5455	-
10 ft Initial SCP Pond Depth	3000	-	5480	-
15 ft Initial SCP Pond Depth (upset)	*3060*	*4430*	*5540*	*-*
Dilution Ratio of SCP Spill at SCP Outlet (Volume from Upstream Catchments (Diverted Around TSF) ***/*** *Volume from SCP Spillway Discharge)* ***(ratio)***				
5 ft Initial SCP Pond Depth	70	-	1200	-
10 ft Initial SCP Pond Depth	40	-	170	-
15 ft Initial SCP Pond Depth (upset)	*20*	*140*	*60*	*-*

Legend
No Discharge from SCP
Discharge from SCP Spillway

*Note: For return period storms greater than 100-year return period: the 1-day storm VOLUME greater than a 100-year 1-day storm VOLUME would overtop the channels to the TSF or the SCP

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Hydrologic Results – 1 in 1000-yr Flood

Source of Water Discharge to the Downstream Environment	1 in 1000-yr Flood Scenario Volumes			
	*1-Day	3-Day	7-Day	30-Day
Volume from Upstream Catchments (Diverted Around TSF) ***(acre-ft)***				
Upstream Catchments (Diverted Around TSF)	2930	4700	5840	n/a
Volume from SCP Spillway Discharge ***(acre-ft)***				
5 ft Initial SCP Pond Depth	180	40	160	0
10 ft Initial SCP Pond Depth	200	70	190	0
15 ft Initial SCP Pond Depth (upset)	*260*	*130*	*240*	*0*
Total Volume to Downstream Environment ***(acre-ft)***				
5 ft Initial SCP Pond Depth	3110	4740	6000	-
10 ft Initial SCP Pond Depth	3130	4770	6020	-
15 ft Initial SCP Pond Depth (upset)	*3190*	*4820*	*6080*	*-*
Dilution Ratio of SCP Spill at SCP Outlet (Volume from Upstream Catchments (Diverted Around TSF) / Volume from SCP Spillway Discharge) ***(ratio)***				
5 ft Initial SCP Pond Depth	20	110	40	-
10 ft Initial SCP Pond Depth	15	70	30	-
15 ft Initial SCP Pond Depth (upset)	*10*	*40*	*20*	*-*

Legend
No Discharge from SCP
Discharge from SCP Spillway

*Note: For return period storms greater than 100-year return period: the 1-day storm VOLUME greater than a 100-year 1-day storm VOLUME would overtop the channels to the TSF or the SCP

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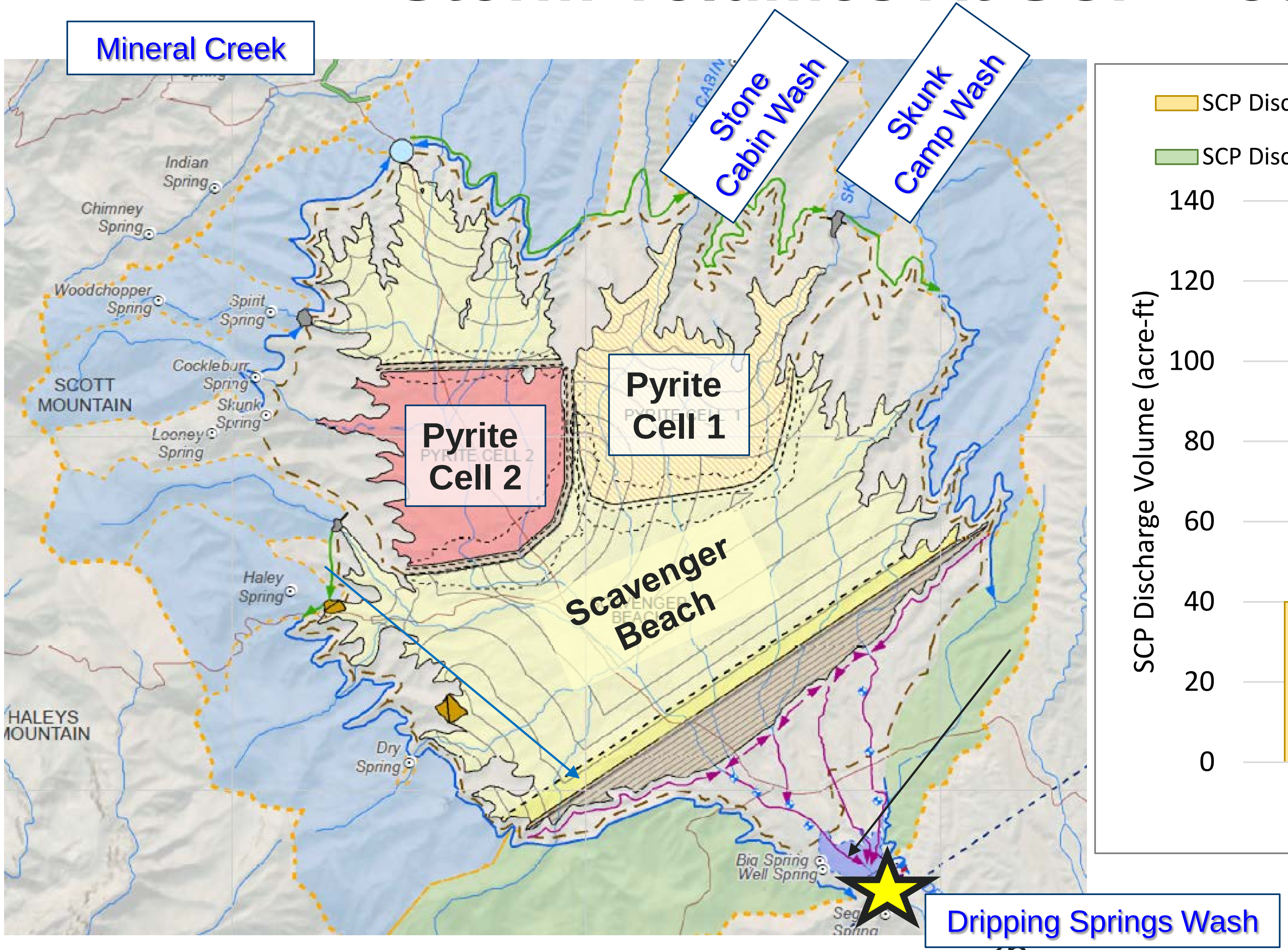
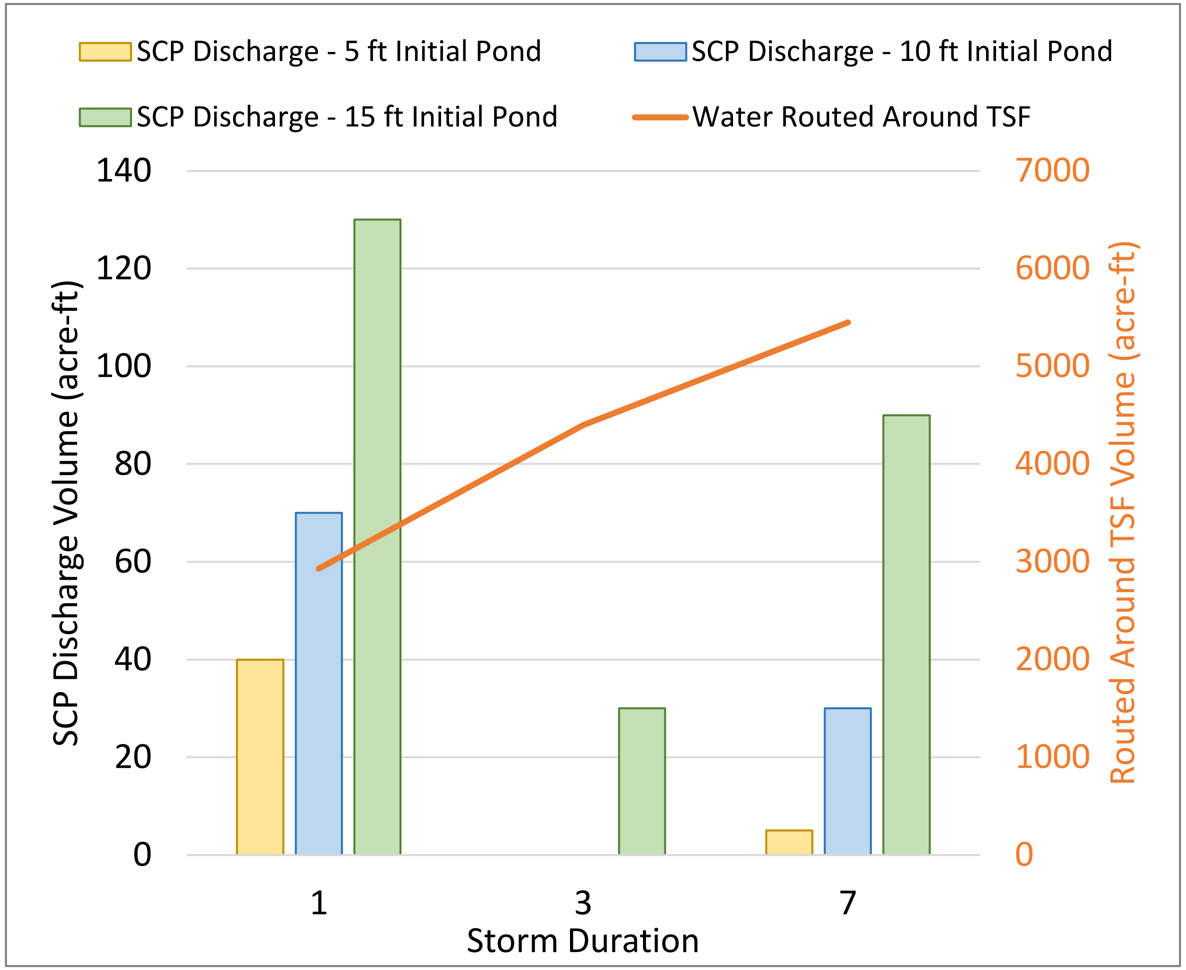
Storm Volumes At SCP – 500-yr Event





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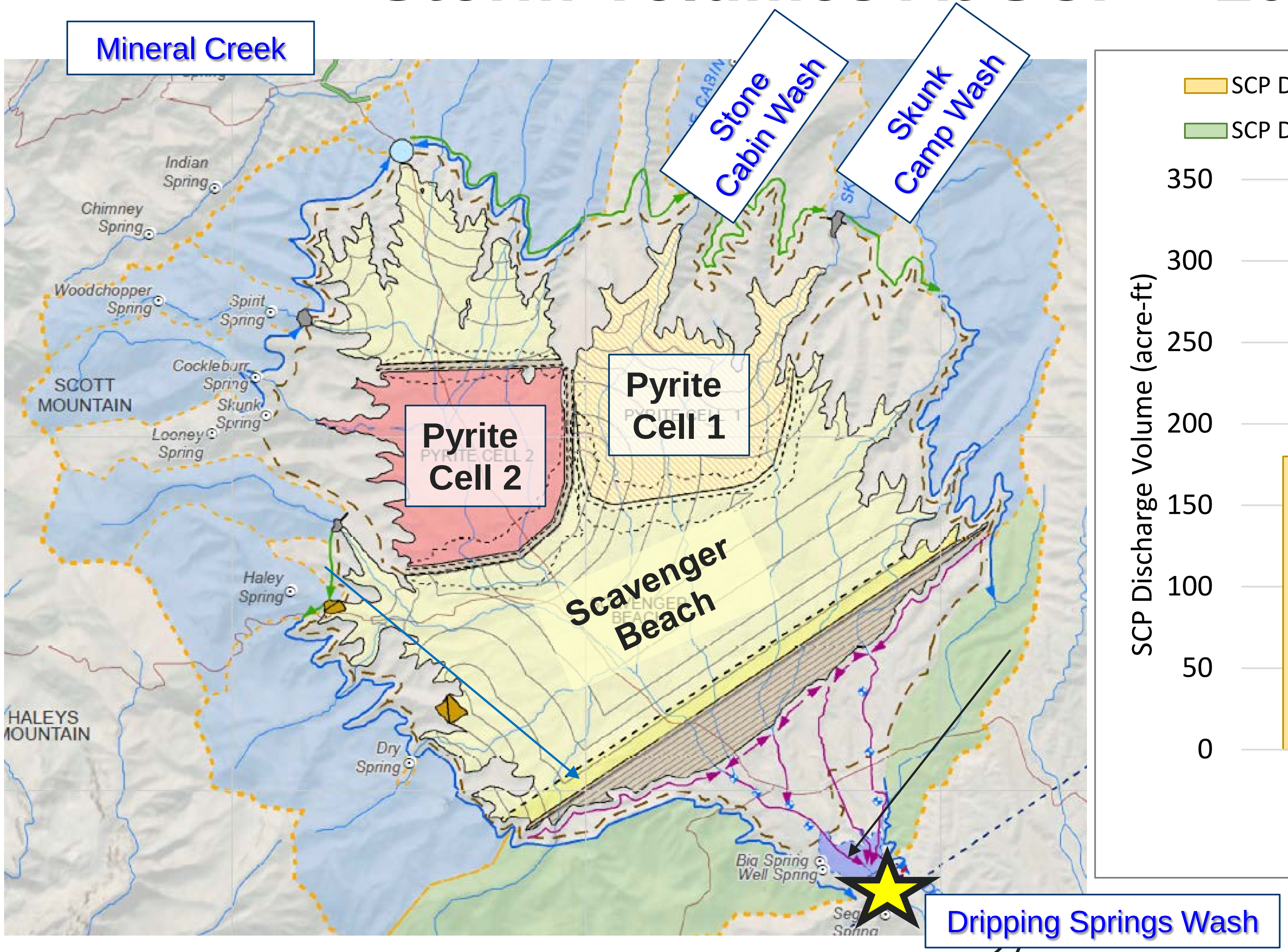
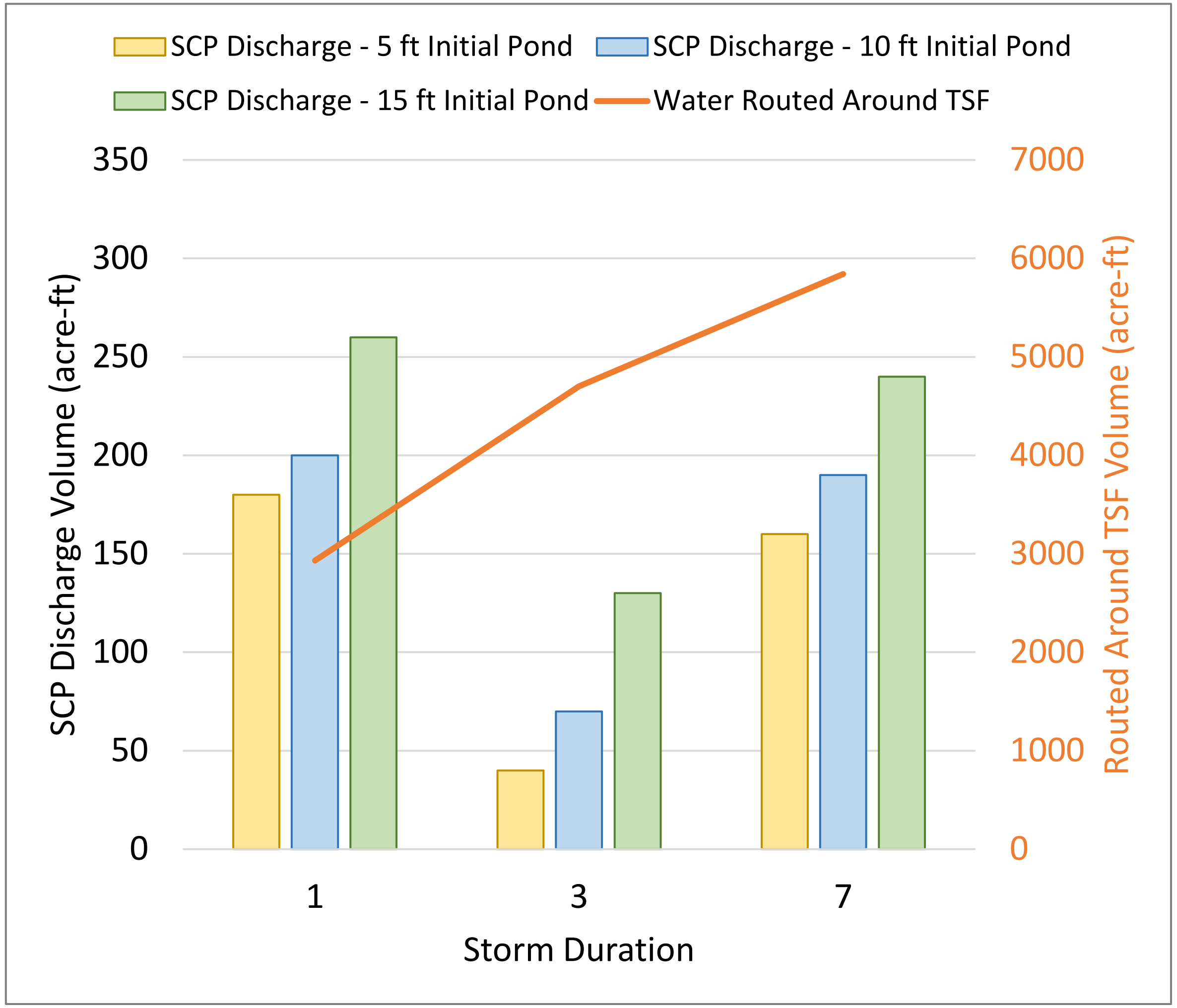
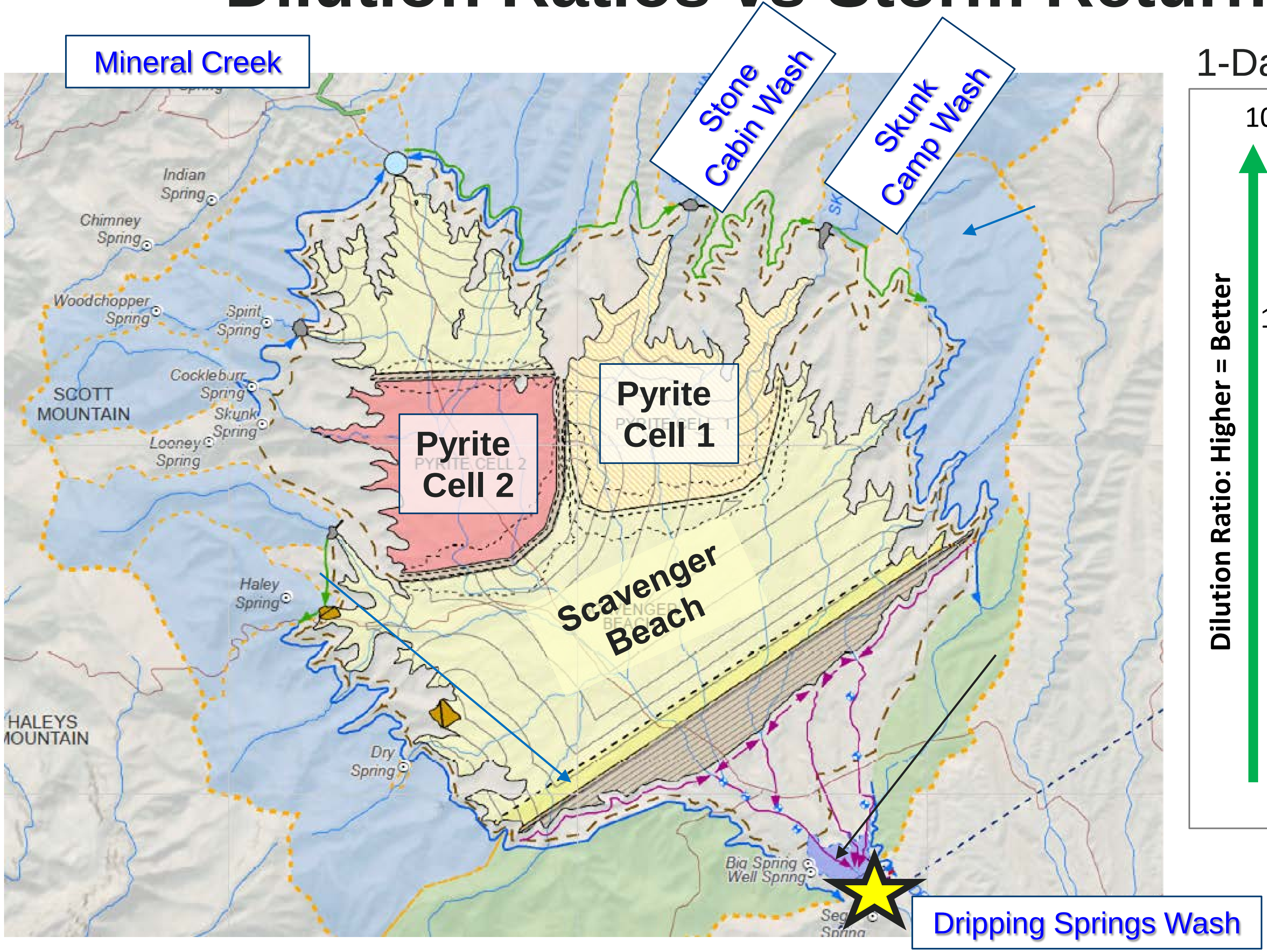
Storm Volumes At SCP – 1000-yr Event

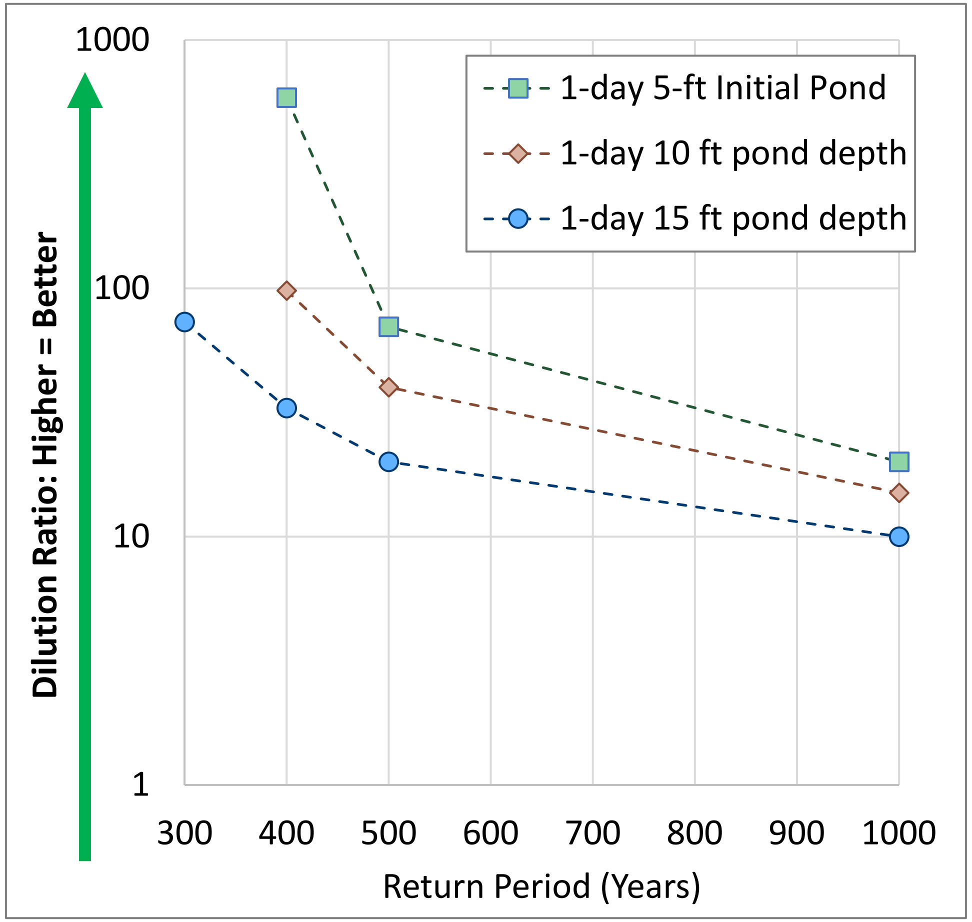




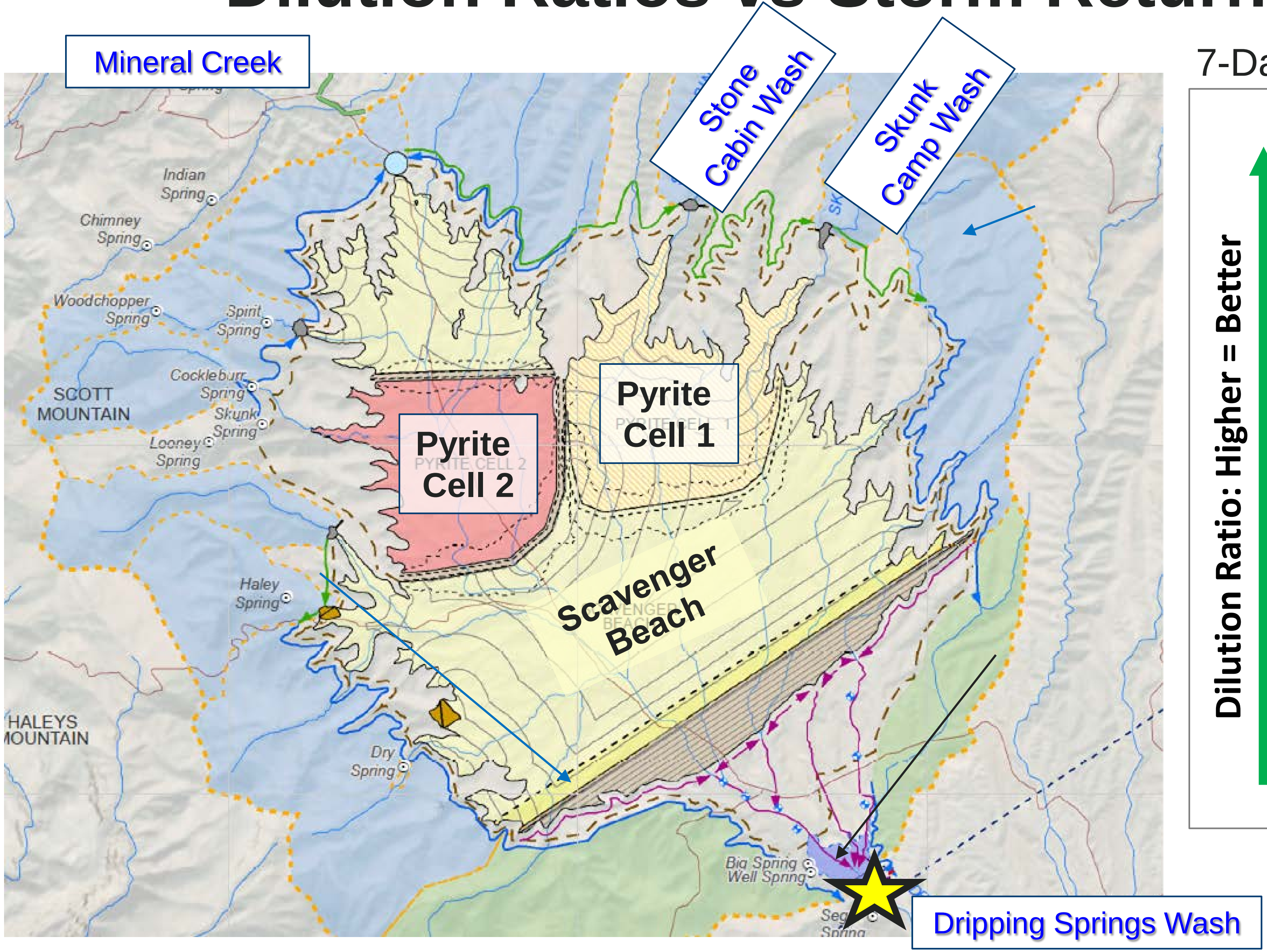
Dilution Ratios vs Storm Return Period At SCP

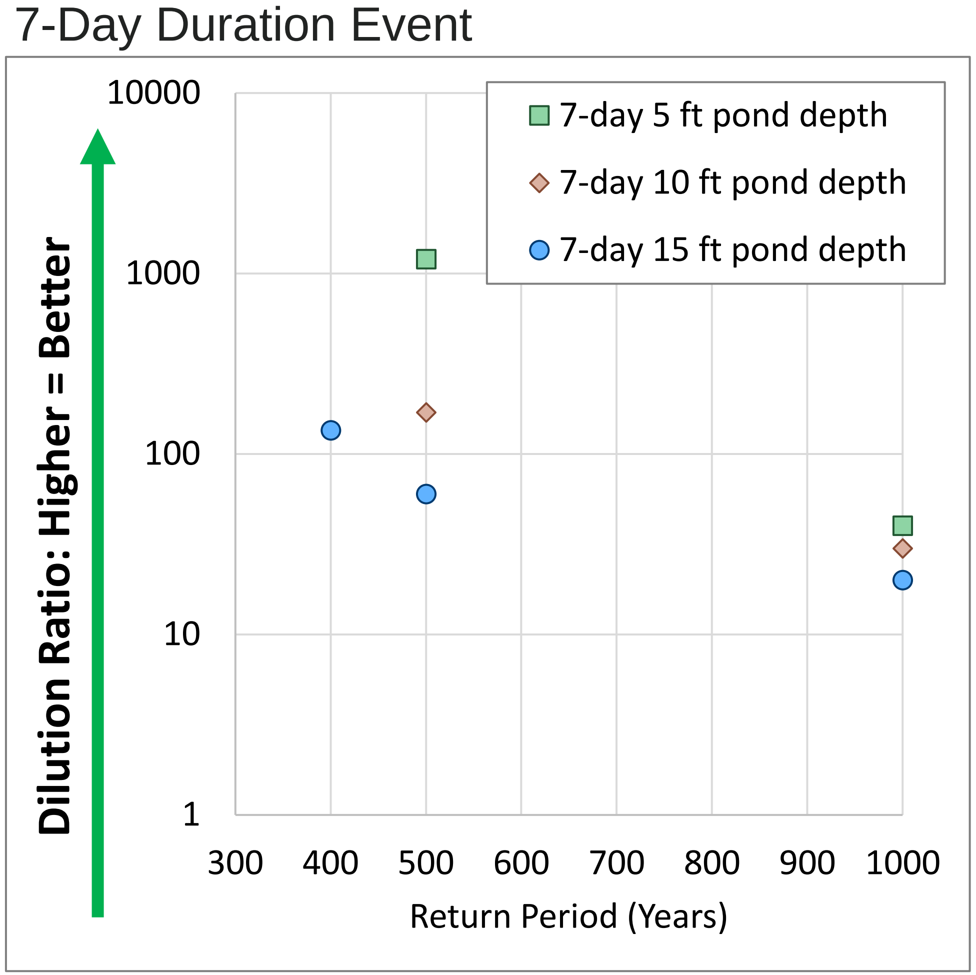


1-Day Duration Event



Dilution Ratios vs Storm Return Period At SCP





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Legend
No Discharge from SCP
Discharge from SCP Spillway
Meets All WQ
Does not meet Cu WQ

Water Quality Results – 1 in 300-yr Flood

Source of Water Discharge to the Downstream Environment	1 in 300-yr Flood Scenario			
	*1-Day	3-Day	7-Day	30-Day
Volume from Upstream Catchments (Diverted Around TSF) **(acre-ft)**				
Upstream Catchments (Diverted Around TSF)	2930	n/a	n/a	n/a
Volume from SCP Spillway Discharge **(acre-ft)**				
5 ft Initial SCP Pond Depth	0	0	0	0
10 ft Initial SCP Pond Depth	0	0	0	0
15 ft Initial SCP Pond Depth (upset)	*40*	*0*	*0*	*0*
Total Volume to Downstream Environment **(acre-ft)**				
5 ft Initial SCP Pond Depth	2930	-	-	-
10 ft Initial SCP Pond Depth	2930	-	-	-
15 ft Initial SCP Pond Depth (upset)	*2970*	-	-	-
Predicted Copper Concentration Just downstream of SCP **(mg/L)**				
5 ft Initial SCP Pond Depth	-	-	-	-
10 ft Initial SCP Pond Depth	-	-	-	-
15 ft Initial SCP Pond Depth (upset)	*0.030*	-	-	-
Predicted Copper Concentration Just downstream of SCP / Surface Water Quality Standard **(ratio)**				
5 ft Initial SCP Pond Depth	-	-	-	-
10 ft Initial SCP Pond Depth	-	-	-	-
15 ft Initial SCP Pond Depth (upset)	*1.9*	-	-	-

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Legend
No Discharge from SCP
Discharge from SCP Spillway
Meets All WQ
Does not meet Cu WQ

Water Quality Results – 1 in 400-yr Flood

Source of Water Discharge to the Downstream Environment	1 in 400-yr Flood Scenario			
	*1-Day	3-Day	7-Day	30-Day
Volume from Upstream Catchments (Diverted Around TSF) **(acre-ft)**				
Upstream Catchments (Diverted Around TSF)	2930	n/a	5400	n/a
Volume from SCP Spillway Discharge **(acre-ft)**				
5 ft Initial SCP Pond Depth	5	0	0	0
10 ft Initial SCP Pond Depth	30	0	0	0
15 ft Initial SCP Pond Depth (upset)	*90*	*0*	*40*	*0*
Total Volume to Downstream Environment **(acre-ft)**				
5 ft Initial SCP Pond Depth	2935	-	-	-
10 ft Initial SCP Pond Depth	2960	-	-	-
15 ft Initial SCP Pond Depth (upset)	*3020*	*-*	*5440*	*-*
Predicted Copper Concentration Just downstream of SCP ***(mg/L)***				
5 ft Initial SCP Pond Depth	0.010	-	-	-
10 ft Initial SCP Pond Depth	0.025	-	-	-
15 ft Initial SCP Pond Depth (upset)	*0.053*	*-*	*0.011*	-
Predicted Copper Concentration Just downstream of SCP / Surface Water Quality Standard ***(ratio)***				
5 ft Initial SCP Pond Depth	0.62	-	-	-
10 ft Initial SCP Pond Depth	1.6	-	-	-
15 ft Initial SCP Pond Depth (upset)	*3.3*	*-*	*0.69*	-

Legend
No Discharge from SCP
Discharge from SCP Spillway
Meets All WQ
Does not meet Cu WQ

Water Quality Results – 1 in 500-yr Flood

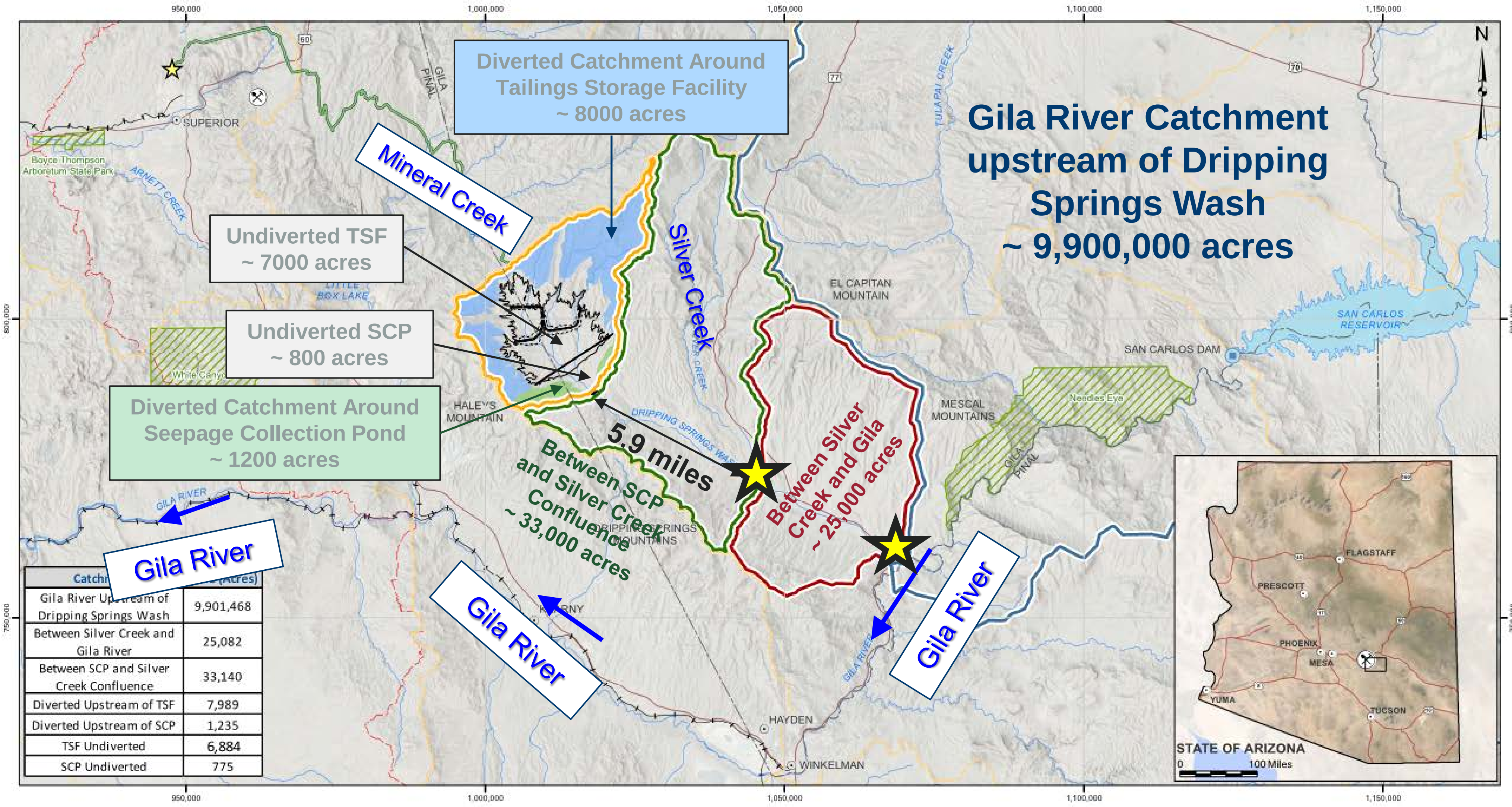
Source of Water Discharge to the Downstream Environment	1 in 500-yr Flood Scenario			
	*1-Day	3-Day	7-Day	30-Day
Volume from Upstream Catchments (Diverted Around TSF) **(acre-ft)**				
Upstream Catchments (Diverted Around TSF)	2930	4400	5450	n/a
Volume from SCP Spillway Discharge **(acre-ft)**				
5 ft Initial SCP Pond Depth	40	0	5	0
10 ft Initial SCP Pond Depth	70	0	30	0
15 ft Initial SCP Pond Depth (upset)	*130*	*30*	*90*	*0*
Total Volume to Downstream Environment **(acre-ft)**				
5 ft Initial SCP Pond Depth	2970	-	5455	-
10 ft Initial SCP Pond Depth	3000	-	5480	-
15 ft Initial SCP Pond Depth (upset)	*3060*	*4430*	*5540*	*-*
Predicted Copper Concentration Just downstream of SCP ***(mg/L)***				
5 ft Initial SCP Pond Depth	0.031	-	0.0070	-
10 ft Initial SCP Pond Depth	0.045	-	0.010	-
15 ft Initial SCP Pond Depth (upset)	*0.071*	*0.016*	*0.017*	-
Predicted Copper Concentration Just downstream of SCP / Surface Water Quality Standard ***(ratio)***				
5 ft Initial SCP Pond Depth	2.0	-	0.45	-
10 ft Initial SCP Pond Depth	2.8	-	0.66	-
15 ft Initial SCP Pond Depth (upset)	*4.3*	*1.0*	*1.1*	-

Legend
No Discharge from SCP
Discharge from SCP Spillway
Meets All WQ
Does not meet Cu WQ

Water Quality Results – 1 in 1000-yr Flood

Source of Water Discharge to the Downstream Environment	1 in 1000-yr Flood Scenario			
	*1-Day	3-Day	7-Day	30-Day
Volume from Upstream Catchments (Diverted Around TSF) **(acre-ft)**				
Upstream Catchments (Diverted Around TSF)	2930	4700	5840	n/a
Volume from SCP Spillway Discharge **(acre-ft)**				
5 ft Initial SCP Pond Depth	180	40	160	0
10 ft Initial SCP Pond Depth	200	70	190	0
15 ft Initial SCP Pond Depth (upset)	*260*	*130*	*240*	*0*
Total Volume to Downstream Environment **(acre-ft)**				
5 ft Initial SCP Pond Depth	3110	4740	6000	-
10 ft Initial SCP Pond Depth	3130	4770	6020	-
15 ft Initial SCP Pond Depth (upset)	*3190*	*4820*	*6080*	-
Predicted Copper Concentration Just downstream of SCP ***(mg/L)***				
5 ft Initial SCP Pond Depth	0.098	0.019	0.025	-
10 ft Initial SCP Pond Depth	0.11	0.027	0.027	-
15 ft Initial SCP Pond Depth (upset)	*0.13*	*0.041*	*0.033*	-
Predicted Copper Concentration Just downstream of SCP / Surface Water Quality Standard ***(ratio)***				
5 ft Initial SCP Pond Depth	6.1	1.2	1.6	-
10 ft Initial SCP Pond Depth	6.7	1.7	1.7	-
15 ft Initial SCP Pond Depth (upset)	*7.5*	*2.5*	*2.0*	-

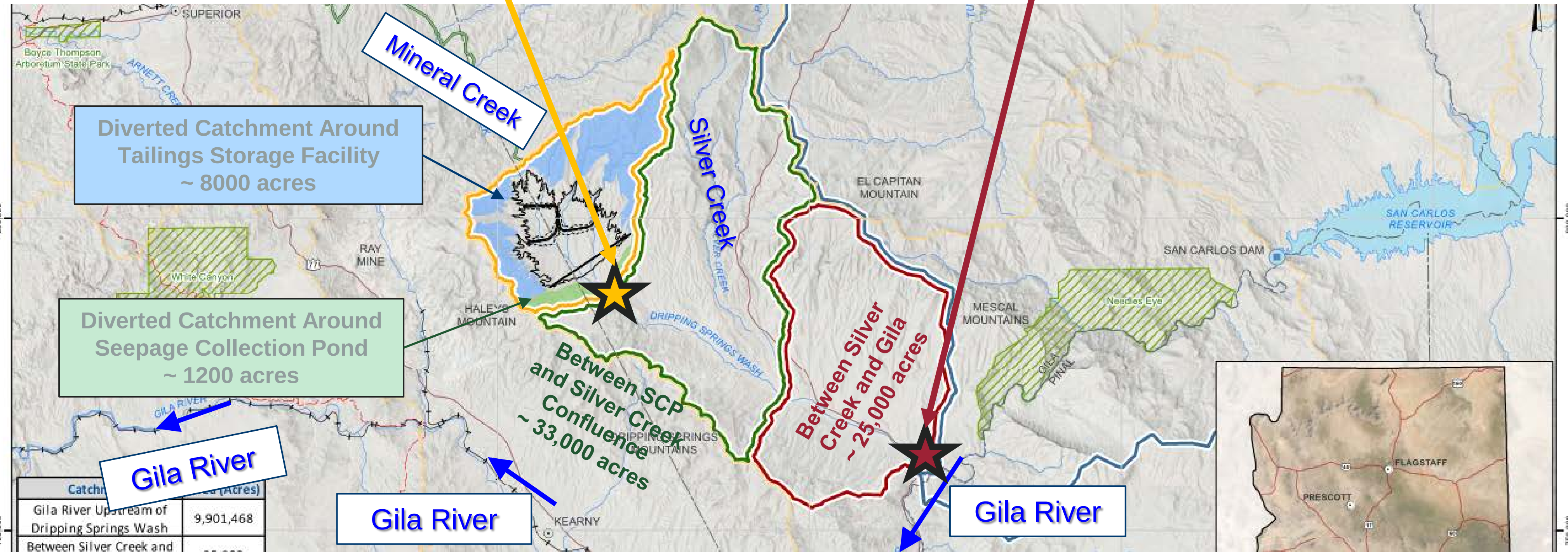
Results Further Downstream



Catch	(Acres)
Gila River Upstream of Dripping Springs Wash	9,901,468
Between Silver Creek and Gila River	25,082
Between SCP and Silver Creek Confluence	33,140
Diverted Upstream of TSF	7,989
Diverted Upstream of SCP	1,235
TSF Undiverted	6,884
SCP Undiverted	775

Hydrologic Results – 1 in 300-yr Flood

Source of Water Discharge to the Downstream Environment	1 in 300-yr Flood Scenario Volumes (acre-ft)			
	1-Day	3-Day	7-Day	30-Day
Dilution Ratio of SCP Spill at SCP Outlet (Volume from Upstream Catchments (Diverted Around TSF) / Volume from SCP Spillway Discharge)				
5 ft Initial SCP Pond Depth	-	-	-	-
10 ft Initial SCP Pond Depth	-	-	-	-
15 ft Initial SCP Pond Depth (upset)	*73*	-	-	-
Dilution Ratio of SCP Spill at Gila River (Volume from Non-contact Catchments / Volume from SCP Spillway Discharge)				
5 ft Initial SCP Pond Depth	-	-	-	-
10 ft Initial SCP Pond Depth	-	-	-	-
15 ft Initial SCP Pond Depth (upset)	*668*	-	-	-



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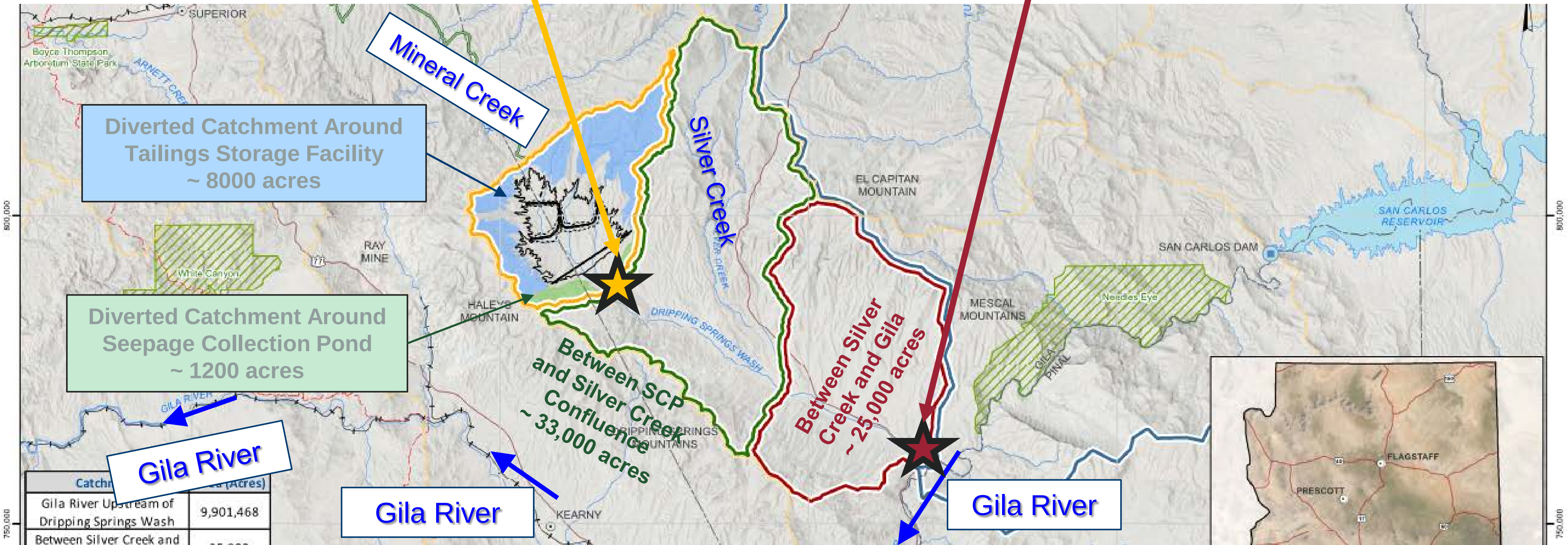
Hydrologic Results – 1 in 400-yr Flood

Source of Water Discharge to the Downstream Environment	1 in 400-yr Flood Scenario Volumes (acre-ft)			
	1-Day	3-Day	7-Day	30-Day
Dilution Ratio of SCP Spill at SCP Outlet (Volume from Upstream Catchments (Diverted Around TSF) / Volume from SCP Spillway Discharge)				
5 ft Initial SCP Pond Depth	586	-	-	-
10 ft Initial SCP Pond Depth	98	-	-	-
15 ft Initial SCP Pond Depth (upset)	*33*	*-*	*135*	*-*
Dilution Ratio of SCP Spill at Gila River (Volume from Non-contact Catchments / Volume from SCP Spillway Discharge)				
5 ft Initial SCP Pond Depth	6286	-	-	-
10 ft Initial SCP Pond Depth	1048	-	-	-
15 ft Initial SCP Pond Depth (upset)	*349*	*-*	*1488*	*-*



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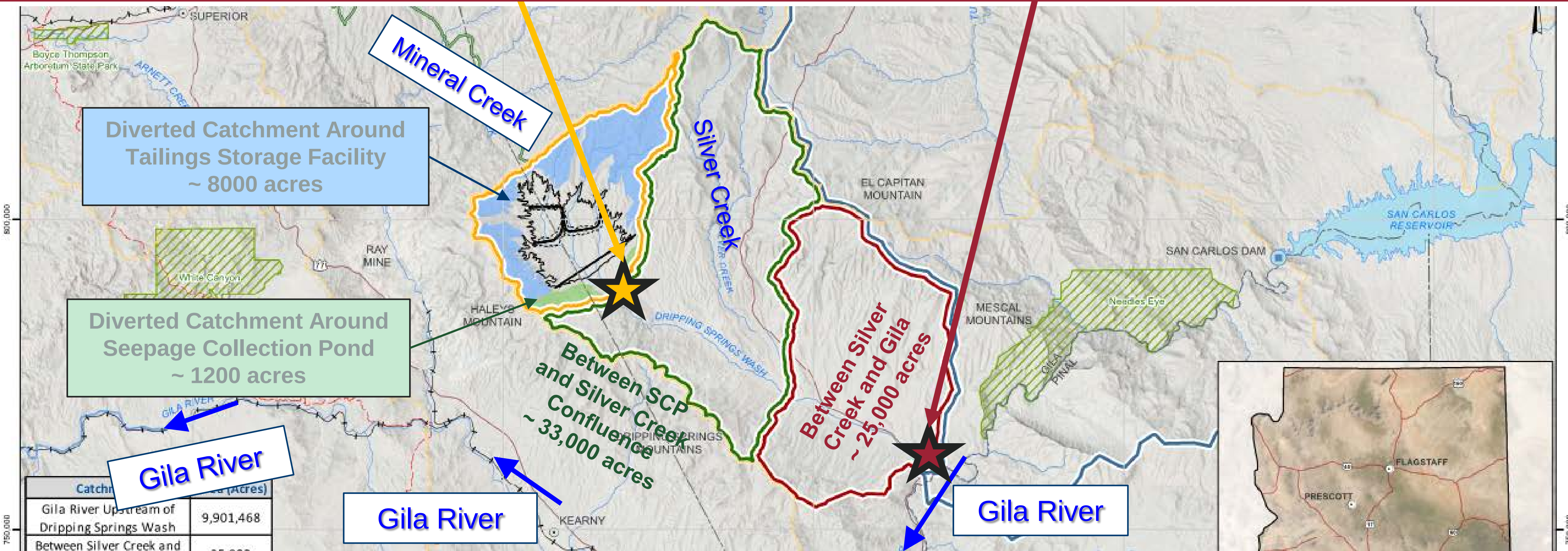
Hydrologic Results – 1 in 500-yr Flood

Source of Water Discharge to the Downstream Environment	1 in 500-yr Flood Scenario Volumes (acre-ft)			
	1-Day	3-Day	7-Day	30-Day
Dilution Ratio of SCP Spill at SCP Outlet (Volume from Upstream Catchments (Diverted Around TSF) / Volume from SCP Spillway Discharge)				
5 ft Initial SCP Pond Depth	70	-	1200	-
10 ft Initial SCP Pond Depth	40	-	170	-
15 ft Initial SCP Pond Depth (upset)	*20*	*140*	*60*	*-*
Dilution Ratio of SCP Spill at Gila River (Volume from Non-contact Catchments / Volume from SCP Spillway Discharge)				
5 ft Initial SCP Pond Depth	906	-	13,370	-
10 ft Initial SCP Pond Depth	518	-	2,228	-
15 ft Initial SCP Pond Depth (upset)	*279*	*2,010*	*743*	*-*



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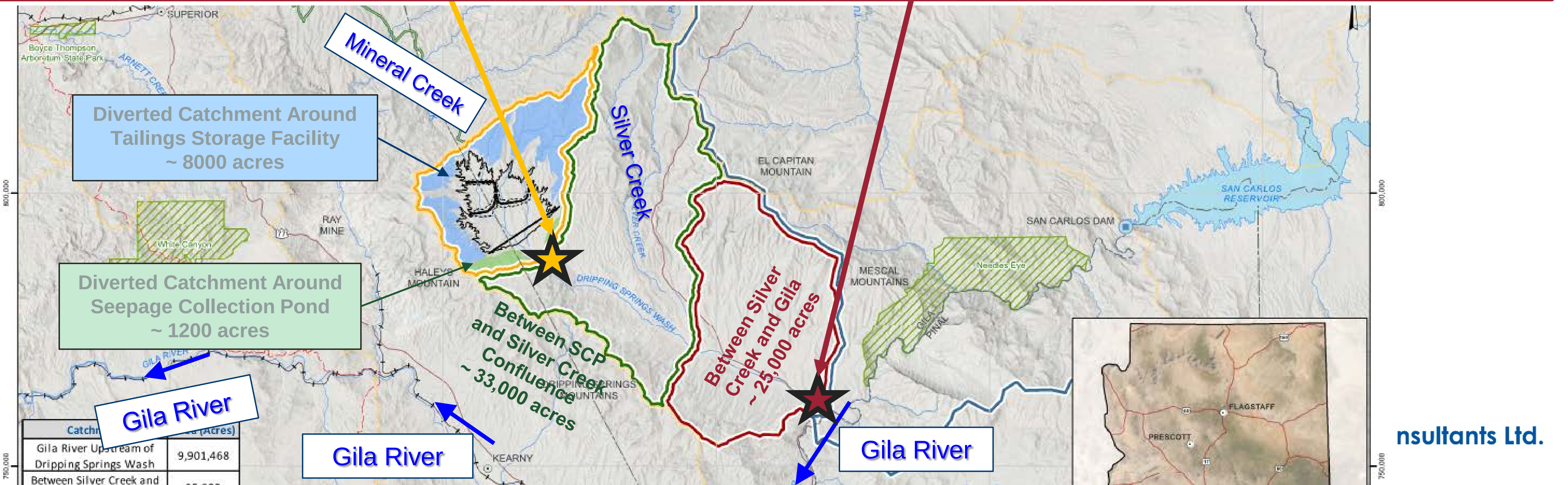
Hydrologic Results – 1 in 1000-yr Flood

Source of Water Discharge to the Downstream Environment	1 in 1000-yr Flood Scenario Volumes (acre-ft)			
	1-Day	3-Day	7-Day	30-Day
Dilution Ratio of SCP Spill at SCP Outlet (Volume from Upstream Catchments (Diverted Around TSF) / Volume from SCP Spillway Discharge)				
5 ft Initial SCP Pond Depth	20	110	40	-
10 ft Initial SCP Pond Depth	15	70	30	-
15 ft Initial SCP Pond Depth (upset)	*10*	*40*	*20*	*-*
Dilution Ratio of SCP Spill at Gila River (Volume from Non-contact Catchments / Volume from SCP Spillway Discharge)				
5 ft Initial SCP Pond Depth	331	2,448	646	-
10 ft Initial SCP Pond Depth	298	1,399	544	-
15 ft Initial SCP Pond Depth (upset)	*229*	*753*	*431*	*-*



Legend
No Discharge from SCP
Discharge from SCP Spillway

Hydrologic Results – 1 in 300-yr Flood

Source of Water Discharge to the Downstream Environment	1 in 300-yr Flood Scenario Volumes			
	*1-Day	3-Day	7-Day	30-Day
Volume from Upstream Catchments (Diverted Around TSF) ***(acre-ft)***				
Upstream Catchments (Diverted Around TSF)	2930	n/a	n/a	n/a
Volume from SCP Spillway Discharge ***(acre-ft)***				
5 ft Initial SCP Pond Depth	0	0	0	0
10 ft Initial SCP Pond Depth	0	0	0	0
15 ft Initial SCP Pond Depth (upset)	*40*	*0*	*0*	*0*
Storm Volume between SCP and Silver Creek Confluence ***(acre-ft)***				
SCP to Silver Creek Catchment	14,400	23,700	26,600	-
Additional Storm Volume between Silver Creek Confluence and Gila River Confluence ***(acre-ft)***				
Silver Creek to Gila River Catchment	9,400	17,200	20,300	-
Total Storm Volume Reporting to Gila River ***(acre-ft)***				
5 ft Initial SCP Pond Depth	-	-	-	-
10 ft Initial SCP Pond Depth	-	-	-	-
15 ft Initial SCP Pond Depth (upset)	*26,770*	-	-	-
Dilution Ratio of SCP Spill at Gila River (Volume from Non-contact Catchments / Volume from SCP Spillway Discharge) ***(ratio)***				
5 ft Initial SCP Pond Depth	-	-	-	-
10 ft Initial SCP Pond Depth	-	-	-	-
15 ft Initial SCP Pond Depth (upset)	*668*	-	-	-

*Note: For return period storms greater than 100-year return period: the 1-day storm VOLUME greater than a 100-year 1-day storm VOLUME would overtop the channels to the TSF or the SCP

**Note: Volume of runoff between Silver Creek Confluence and Gila River Confluence was calculated using regional regression equations.

Legend
No Discharge from SCP
Discharge from SCP Spillway

Hydrologic Results – 1 in 400-yr Flood

Source of Water Discharge to the Downstream Environment	1 in 400-yr Flood Scenario Volumes			
	*1-Day	3-Day	7-Day	30-Day
Volume from Upstream Catchments (Diverted Around TSF) ***(acre-ft)***				
Upstream Catchments (Diverted Around TSF)	2930	n/a	5400	n/a
Volume from SCP Spillway Discharge ***(acre-ft)***				
5 ft Initial SCP Pond Depth	5	0	0	0
10 ft Initial SCP Pond Depth	30	0	0	0
15 ft Initial SCP Pond Depth (upset)	*90*	*0*	*40*	*0*
Storm Volume between SCP and Silver Creek Confluence ***(acre-ft)***				
SCP to Silver Creek Catchment	17,400	28,200	30,700	-
Additional Storm Volume between Silver Creek Confluence and Gila River Confluence ***(acre-ft)***				
Silver Creek to Gila River Catchment	11,100	20,100	23,400	-
Total Storm Volume Reporting to Gila River ***(acre-ft)***				
5 ft Initial SCP Pond Depth	31,435	-	-	-
10 ft Initial SCP Pond Depth	31,460	-	-	-
15 ft Initial SCP Pond Depth (upset)	*31,520*	*-*	*59,540*	*-*
Dilution Ratio of SCP Spill at Gila River (Volume from Non-contact Catchments / Volume from SCP Spillway Discharge) ***(ratio)***				
5 ft Initial SCP Pond Depth	6286	-	-	-
10 ft Initial SCP Pond Depth	1048	-	-	-
15 ft Initial SCP Pond Depth (upset)	*349*	*-*	*1488*	*-*

*Note: For return period storms greater than 100-year return period: the 1-day storm VOLUME greater than a 100-year 1-day storm VOLUME would overtop the channels to the TSF or the SCP

**Note: Volume of runoff between Silver Creek Confluence and Gila River Confluence was calculated using regional regression equations.

Legend
No Discharge from SCP
Discharge from SCP Spillway

Hydrologic Results – 1 in 500-yr Flood

Source of Water Discharge to the Downstream Environment	1 in 500-yr Flood Scenario Volumes			
	*1-Day	3-Day	7-Day	30-Day
Volume from Upstream Catchments (Diverted Around TSF) ***(acre-ft)***				
Upstream Catchments (Diverted Around TSF)	2930	4400	5450	n/a
Volume from SCP Spillway Discharge ***(acre-ft)***				
5 ft Initial SCP Pond Depth	40	0	5	0
10 ft Initial SCP Pond Depth	70	0	30	0
15 ft Initial SCP Pond Depth (upset)	*130*	*30*	*90*	*0*
Storm Volume between SCP and Silver Creek Confluence ***(acre-ft)***				
SCP to Silver Creek Catchment	20,400	32,800	34,900	-
Additional Storm Volume between Silver Creek Confluence and Gila River Confluence ***(acre-ft)***				
Silver Creek to Gila River Catchment	12,900	23,100	26,500	-
Total Storm Volume Reporting to Gila River ***(acre-ft)***				
5 ft Initial SCP Pond Depth	36,270	60,300	66,850	-
10 ft Initial SCP Pond Depth	36,300	60,300	66,880	-
15 ft Initial SCP Pond Depth (upset)	*36,360*	*60,330*	*66,940*	*-*
Dilution Ratio of SCP Spill at Gila River (Volume from Non-contact Catchments / Volume from SCP Spillway Discharge) ***(ratio)***				
5 ft Initial SCP Pond Depth	906	-	13,370	-
10 ft Initial SCP Pond Depth	518	-	2,228	-
15 ft Initial SCP Pond Depth (upset)	*279*	*2,010*	*743*	*-*

*Note: For return period storms greater than 100-year return period: the 1-day storm VOLUME greater than a 100-year 1-day storm VOLUME would overtop the channels to the TSF or the SCP

**Note: Volume of runoff between Silver Creek Confluence and Gila River Confluence was calculated using regional regression equations.

Legend
No Discharge from SCP
Discharge from SCP Spillway

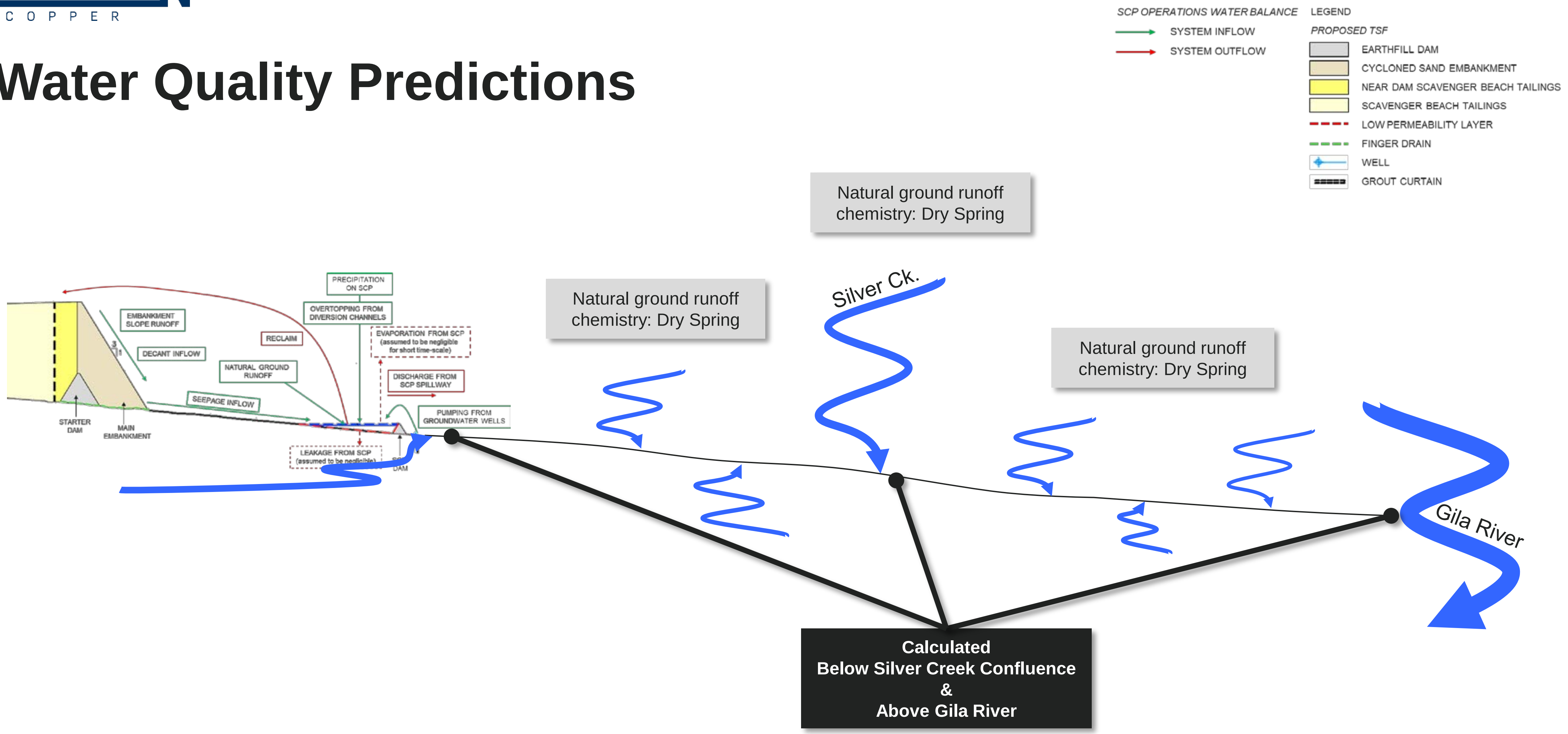
Hydrologic Results – 1 in 1000-yr Flood

Source of Water Discharge to the Downstream Environment	1 in 1000-yr Flood Scenario Volumes			
	*1-Day	3-Day	7-Day	30-Day
Volume from Upstream Catchments (Diverted Around TSF) ***(acre-ft)***				
Upstream Catchments (Diverted Around TSF)	2930	4700	5840	n/a
Volume from SCP Spillway Discharge ***(acre-ft)***				
5 ft Initial SCP Pond Depth	180	40	160	0
10 ft Initial SCP Pond Depth	200	70	190	0
15 ft Initial SCP Pond Depth (upset)	*260*	*130*	*240*	*0*
Storm Volume between SCP and Silver Creek Confluence ***(acre-ft)***				
SCP to Silver Creek Catchment	35,100	55,300	55,500	-
Additional Storm Volume between Silver Creek Confluence and Gila River Confluence ***(acre-ft)***				
Silver Creek to Gila River Catchment	21,600	37,900	42,000	-
Total Storm Volume Reporting to Gila River ***(acre-ft)***				
5 ft Initial SCP Pond Depth	59,810	97,940	103,500	-
10 ft Initial SCP Pond Depth	59,830	97,970	103,530	-
15 ft Initial SCP Pond Depth (upset)	*59,890*	*98,030*	*103,580*	*-*
Dilution Ratio of SCP Spill at Gila River (Volume from Non-contact Catchments / Volume from SCP Spillway Discharge) ***(ratio)***				
5 ft Initial SCP Pond Depth	331	2,448	646	-
10 ft Initial SCP Pond Depth	298	1,399	544	-
15 ft Initial SCP Pond Depth (upset)	*229*	*753*	*431*	*-*

*Note: For return period storms greater than 100-year return period: the 1-day storm VOLUME greater than a 100-year 1-day storm VOLUME would overtop the channels to the TSF or the SCP

**Note: Volume of runoff between Silver Creek Confluence and Gila River Confluence was calculated using regional regression equations.

Water Quality Predictions



NOT TO SCALE

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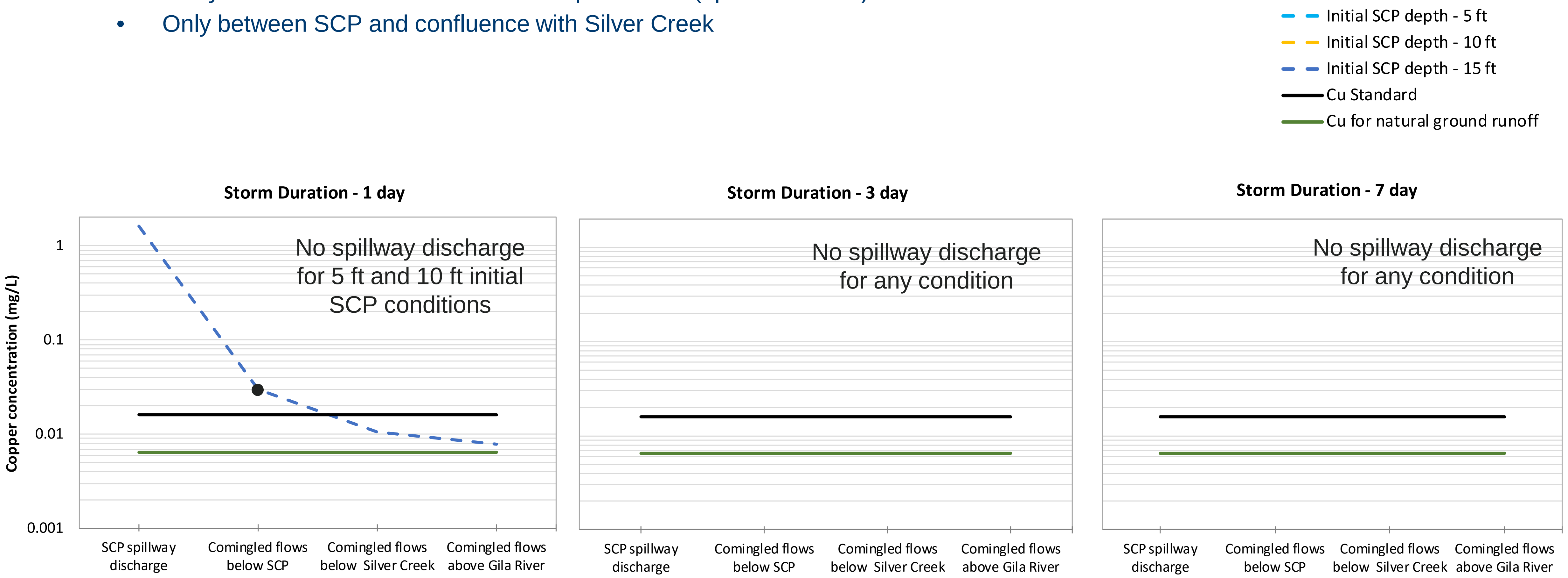
Stormwater quality predictions – 1 in 300-yr Flood

Only predicted constituent of concern is copper for:

- 1 day storm duration with initial SCP depth of 15 ft (upset condition)
- Only between SCP and confluence with Silver Creek



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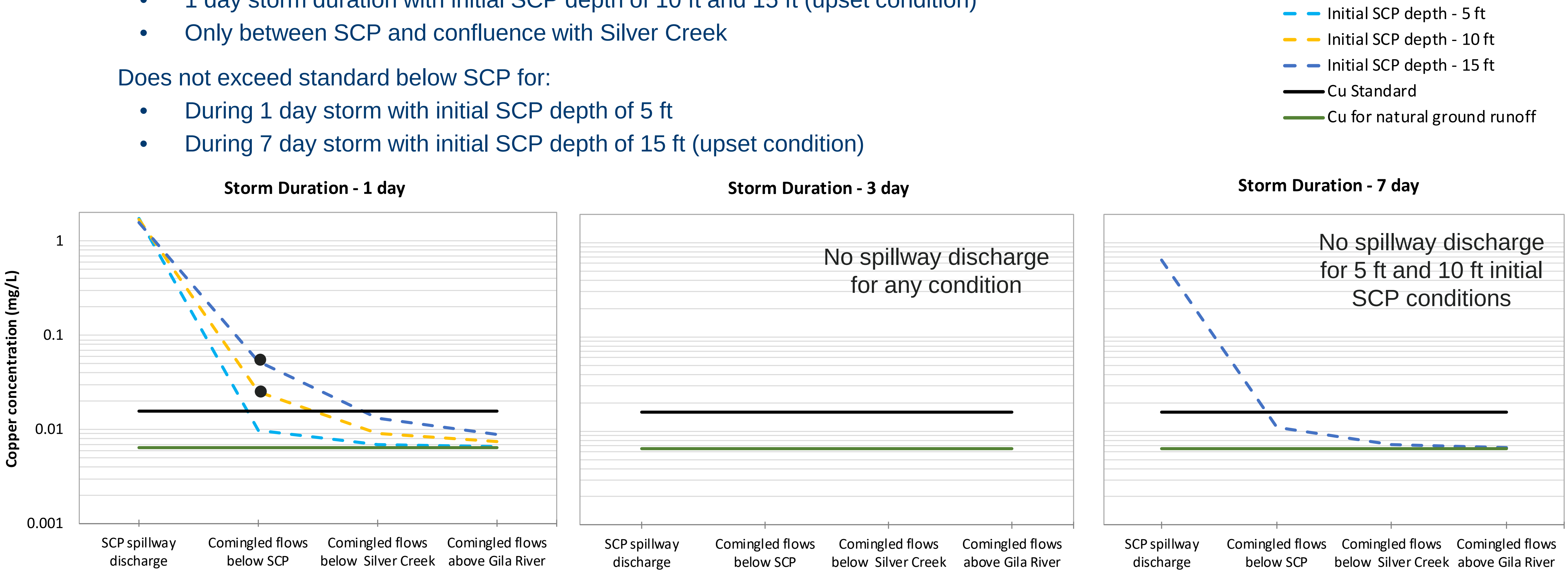
Stormwater quality predictions – 1 in 400-yr Flood

Only predicted constituent of concern is copper for:

- 1 day storm duration with initial SCP depth of 10 ft and 15 ft (upset condition)
- Only between SCP and confluence with Silver Creek

Does not exceed standard below SCP for:

- During 1 day storm with initial SCP depth of 5 ft
- During 7 day storm with initial SCP depth of 15 ft (upset condition)



KCB Consultants Ltd.

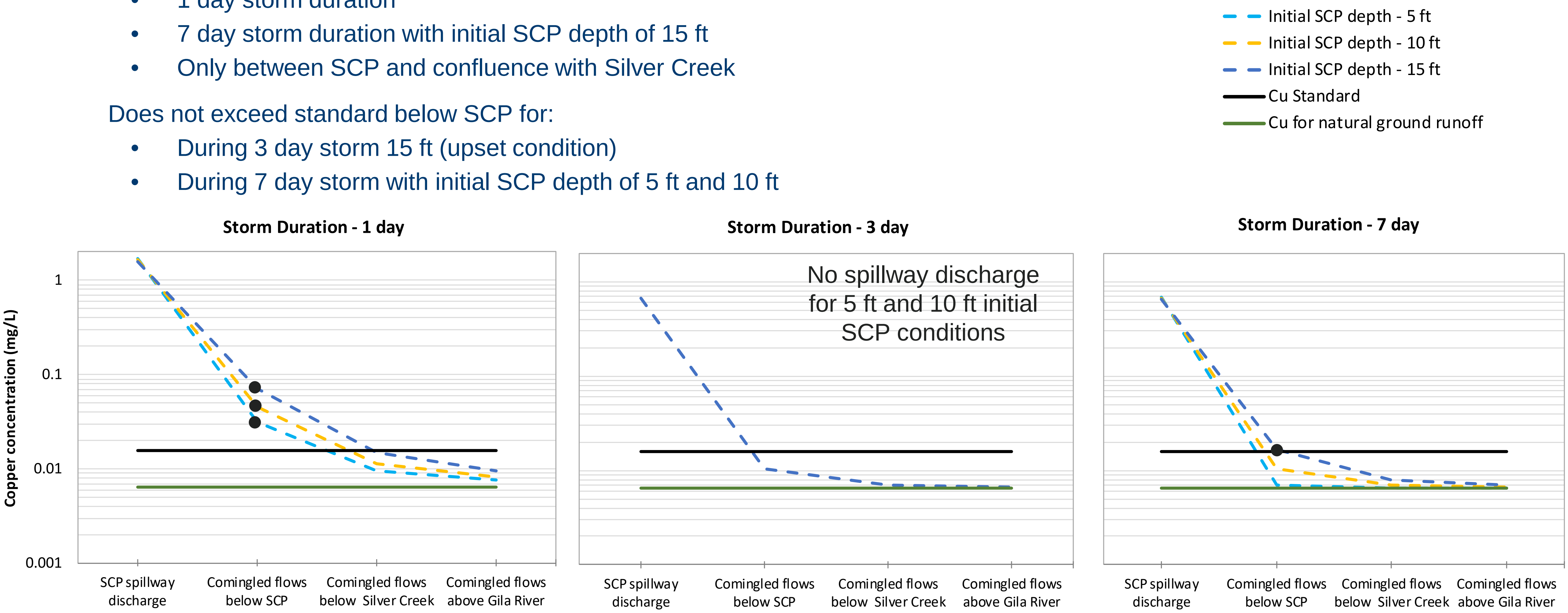
Stormwater quality predictions – 1 in 500-yr Flood

Only predicted constituent of concern is copper for:

- 1 day storm duration
- 7 day storm duration with initial SCP depth of 15 ft
- Only between SCP and confluence with Silver Creek

Does not exceed standard below SCP for:

- During 3 day storm 15 ft (upset condition)
- During 7 day storm with initial SCP depth of 5 ft and 10 ft

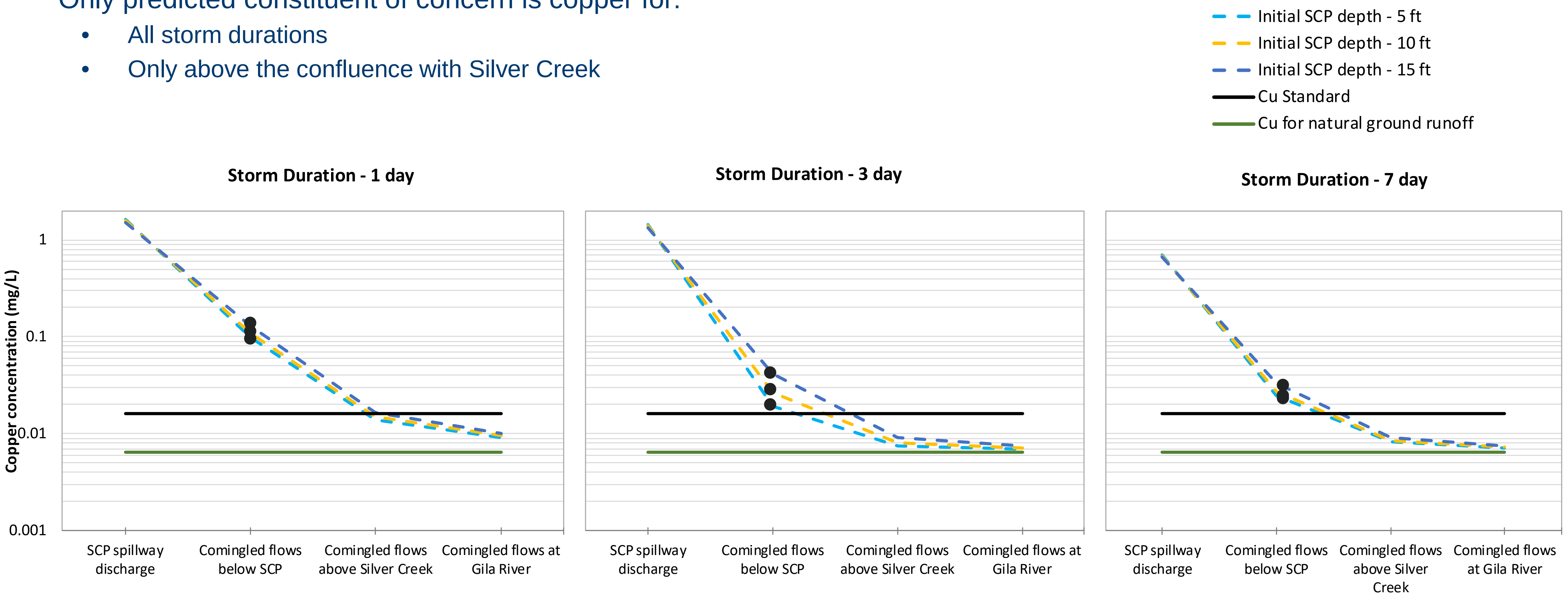


KCB Consultants Ltd.

Stormwater quality predictions – 1 in 1000-yr Flood

Only predicted constituent of concern is copper for:

- All storm durations
- Only above the confluence with Silver Creek



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WR-20: Provide Input on Potential for Stormwater Release and Estimate of Quality. Focus on Operations.

Overview

- Introduction
- Review of Skunk Camp TSF stormwater management
- What happens during the 300-year to 1000-year events?
  - Stormwater release volumes and downstream dilution
  - Release water quality
- Conclusion / discussion

Conclusions

- The Skunk Camp TSF storm water management plan:
  - Storm storage designed above minimum regulatory requirements
  - Design is robust with contingencies
  - Only under very extreme scenarios is there spill through the spillway to the downstream environment
  - Under these scenarios, the spill is a small volume compared non-contact flows and Gila River flows
- Water quality impacts of the SCP spill in 300yr - 1000yr events:
  - Predicted exceedances only for copper
  - Calculated copper standard low ~0.016 mg/L
  - Predicted exceedances only between the SCP and Silver Creek confluence
  - Predicted exceedances ≤ 7.5 times calculated standard